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KNOWLEDGE OF RESULTS AND CONTINUITY OF VARIOUS TECHNIQUES IN PRESENTING A FILMSTRIP AS FACTORS IN IMMEDIATE LEARNING AND RETENTION.

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THIS RESEARCH EFFORT WAS DESIGNED TO INVESTIGATE THE EFFECTS OF (1) TWO DEGREES OF IMMEDIACY OF KNOWLEDGE OF RESULTS AND (2) THREE METHODS OF PRESENTATION ON THE RETENTION OF KNOWLEDGE TRANSMITTED BY A FILMSTRIP. A FILMSTRIP WAS PRESENTED FRAME-BY-FRAME, IN SEQUENCE, AND IN TOTAL WITH TEST ITEMS ON THE FILMSTRIP ADMINISTERED ACCORDINGLY. PUBLIC SCHOOL STUDENTS FROM GRADES 5, 6, 7, 8, AND 11 WERE RANDOMLY ASSIGNED WITHIN EACH GRADE-GROUP TO 6 DIFFERENT TREATMENT GROUPS. EXPERIMENTAL GROUP SUBJECTS IN EACH OF THE THREE PRESENTATION SCHEDULES KNEW IF THEIR RESPONSES WERE CORRECT IMMEDIATELY UPON ANSWERING EACH TEST ITEM. THE OTHER HALF (CONTROL GROUP) RECEIVED KNOWLEDGE OF RESULTS ON THE DAY FOLLOWING PRESENTATION. STUDENTS WERE TESTED AGAIN APPROXIMATELY 3 WEEKS AFTER THE FILMSTRIP PRESENTATION. THE FINDINGS WERE EQUIVOCAL, AND THE AUTHOR RECOMMENDS FURTHER STUDY. (JK)

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TABLE OF CONTENTS

Page

Acknowledgments ii

List of Tables v

List of Figures x

I. INTRODUCTION

General Statement of the Problem 4
Origin and Importance of the Study 5
Definition of Terms 7
Specific Statement of the Problem 9
Limitations of the Study 11

II. REVIEW OF THE LITERATURE

Introduction to Knowledge of Results 15
Introduction to Part Versus Whole Learning . . 17
Psychology 19
Knowledge of Results 20
Part Versus Whole Learning 23
Film Research 24
Knowledge of Results 25
Part Versus Whole Learning 29
Teaching Machine and Programmed Learning Research 30
Knowledge of Results 30
Part Versus Whole Learning 38

III. PROCEDURES

Selection of Filmstrip and Test Validation 43
Preparation of Filmstrip Test 45
Arrangement for the Methods of Filmstrip Presentation 46
Frame Method 46
Sequence Method 47
Whole Method 47
"Hardware" Selected and Provision for Experimental and Control Groups 47
Procedure for the Experimental and Control Groups in Four Sessions 49
Pre-treatment Testing Session 49
Treatment Session 52
Delayed Knowledge of Results Testing Session 56
Retention Testing Session 57

Page

Selection of School Population and Trial Run 61
Treatment and Analysis of Data 70

IV. ANALYSIS OF DATA

Total Methods 75
Total Results 80
Total Grades 85
Methods x Results 91
Grades x Results 98
Grades x Methods 107
Grades x Methods x Results 117
A Summary Analysis of Adjusted Means 132
Sources of Variation and Interaction Variance . . . 138

V. SUMMARY OF THE STUDY

Statement of the Problem 142
Procedures 142
Results with Related Conclusions 144
Implications and Recommendations 154

BIBLIOGRAPHY 159

APPENDIX A: Tables 54 to 57 171

APPENDIX B: Criterion Measure 176

APPENDIX C: 35mm Slide Series on the Use of the Punchboard Device 193

APPENDIX D: Part I - Practice Test 204
Part II - Science Achievement Test 208

APPENDIX E: Directions for Filmstrip Presentation and Testing Sessions 214

APPENDIX F: Prospectus Submitted to County School Office and to Participating Principals 219

APPENDIX G: Tables 58 to 64 223

LIST OF TABLES

Table		Page
1	Composition and Treatment of Experimental and Control Groups (1-18)	55
2	A Description of the Various Test Sessions for Grade 5-6	58
3	A Description of the Various Test Sessions for Grade 7-8	59
4	A Description of the Various Test Sessions for Grade 11	60
5	An Analysis of the Inactive Sample for Grade Level Variables	64
6	An Analysis of the Inactive Sample for Methods Variables	65
7	An Analysis of the Inactive Sample for Knowledge of Results Variables	66
8	Number of Times Absent by Those in the Inactive Sample	68
9	Session(s) Missed by Those Absent in the Inactive Sample	69
10	Symmetric Correlation Matrix of Test Scores for Grade 5-6	72
11	Symmetric Correlation Matrix of Test Scores for Grade 7-8	73
12	Summary of Results Based on an Analysis of Covariance for Methods Variables --Treatment Session	76
13	Summary of Results Based on an Analysis of Covariance for Methods Variables -- Delayed Knowledge of Results Testing Session	77
14	Summary of Results Based on an Analysis of Covariance for Methods Variables -- Retention Testing Session	78

Table | Page

15 Adjusted Mean Scores for Methods Variables -- Treatment Session 79

16 Summary of Results Based on an Analysis of Covariance for Knowledge of Results Variables -- Treatment Session. 82

17 Summary of Results Based on an Analysis of Covariance for Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session . . . 83

18 Summary of Results Based on an Analysis of Covariance for Knowledge of Results Variables -- Retention Testing Session 84

19 Summary of Results Based on an Analysis of Covariance for Grade Level Variables -- Treatment Session 86

20 Summary of Results Based on an Analysis of Covariance for Grade Level Variables -- Delayed Knowledge of Results Testing Session 87

21 Summary of Results Based on an Analysis of Covariance for Grade Level Variables -- Retention Testing Session 88

22 Adjusted Mean Scores for Grade Level Variables -- Treatment Session 89

23 Adjusted Mean Scores for Grade Level Variables -- Delayed Knowledge of Results Testing Session . . . 89

24 Adjusted Mean Scores for Grade Level Variables -- Retention Testing Session 90

25 Summary of Results Based on an Analysis of Covariance for Methods Variables x Knowledge of Results Variables -- Treatment Session 92

26 Summary of Results Based on an Analysis of Covariance for Methods Variables x Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session 93

27 Summary of Results Based on an Analysis of Covariance for Methods Variables x Knowledge of Results Variables -- Retention Testing Session 94

Table Page

28 Adjusted Mean Scores for Methods Variables x Knowledge of Results Variables -- Treatment Session 95

29 Adjusted Mean Scores for Methods Variables x Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session 97

30 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Knowledge of Results Variables -- Treatment Session 99

31 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session 100

32 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Knowledge of Results Variables -- Retention Testing Session 101

33 Adjusted Mean Scores for Grade Level Variables x Knowledge of Results Variables -- Treatment Session 102

34 Adjusted Mean Scores for Grade Level Variables x Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session 104

35 Adjusted Mean Scores for Grade Level Variables x Knowledge of Results Variables -- Retention Testing Session 105

36 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Methods Variables -- Treatment Session 108

37 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Methods Variables -- Delayed Knowledge of Results Testing Session 109

38 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Methods Variables -- Retention Testing Session 110

39 Adjusted Mean Scores for Grade Level Variables x Methods Variables -- Treatment Session 111

Table Page

40 Adjusted Mean Scores for Grade Level Variables x Methods Variables -- Delayed Knowledge of Results Testing Session 113

41 Adjusted Mean Scores for Grade Level Variables x Methods Variables -- Retention Testing Session 114

42 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Methods Variables x Knowledge of Results Variables -- Treatment Session 118

43 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Methods Variables x Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session . . . 119

44 Summary of Results Based on an Analysis of Covariance for Grade Level Variables x Methods Variables x Knowledge of Results Variables -- Retention Testing Session 120

45 Adjusted Mean Scores for Grade Level Variables x Methods Variables x Knowledge of Results Variables -- Treatment Session 121

46 Adjusted Mean Scores for Grade Level Variables x Methods Variables x Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session 125

47 Adjusted Mean Scores for Grade Level Variables x Methods Variables x Knowledge of Results Variables -- Retention Testing Session 128

48 Adjusted Means for Grade Level Variables, Methods Variables, and Knowledge of Results Variables -- Treatment Session 133

49 Adjusted Means for Grade Level Variables, Methods Variables, and Knowledge of Results Variables -- Delayed Knowledge of Results Testing Session 134

50 Adjusted Means for Grade Level Variables, Methods Variables, and Knowledge of Results Variables -- Retention Testing Session 136

Table Page

51 Analysis of Variance of Adjusted Means for Treatment Testing Session 139

52 Analysis of Variance of Adjusted Means for Delayed Knowledge of Results Testing Session 140

53 Analysis of Variance of Adjusted Means for Retention Testing Session 141

54 Presentation Schedule for Methods Groups and Results Groups . . . .

55 Frame Method: The Numbers of the Information-Frames and Accompanying Question-Frames 173

56 Sequence Method: The Sequence Number Accompanied by the Numbers of the Information-Frames and Question-Frames for that Sequence 174

57 A Summary of the Number of Information-Frames and Question-Frames Per Sequence 175

58 A Description of the Active Sample for Methods Variables 224

59 A Description of the Active Sample for Knowledge of Results Variables 225

60 A Description of the Active Sample for Grade Level Variables 226

61 A Description of the Active Sample for Methods Variables x Knowledge of Results Variables . . . 227

62 A Description of the Active Sample for Grade Level Variables x Knowledge of Results Variables 229

63 A Description of the Active Sample for Methods Variables x Grade Level Variables 231

64 A Description of the Active Sample for Grade Level Variables x Methods Variables x Knowledge of Results Variables 233

LIST OF FIGURES

Figure Page

1 The Rapid Rater: A Punchboard Device 48

Chapter I

INTRODUCTION

The incessant drive of western man to achieve optimum effectiveness in education is being threatened by the mounting pressure which bears down upon the modern educator. The pressure exists in the form of an explosive increase in both knowledge and population. The traditional educational process will endure, only if today's educators succeed in meeting the challenge of teaching a curriculum, which is continuously growing broader and deeper, to a student population that is always expanding. The force of this pressure has already become so great that it cannot be met by simply building more schools and training more teachers. Classroom techniques must be improved and education must become more efficient. The rapid acquisition of new knowledge and new technology also provide us with the resources for solving such problems. Thus, education must accept the fact that changes in educational practices are possible and inevitable.

One way of meeting these problems is by teaching more students at one time with mass instructional techniques. Such procedures increase the student-teacher ratio and as a result sacrifice most of the productive interchange between the teacher and the student which takes place in a small classroom. The once face-to-face teaching situation, hence, is giving way to large group presentational media such as films, filmstrips, tape recordings, and television, which are only one-way stimulus devices.

Skinner (95) fears that the widespread use of equipment designed simply to present material will cause the student to become more and more a mere passive receiver of instruction. In this regard, Porter (86:1) notes that ". . . each technological advance has generally led to decreased teacher contact with students and thus left the actual learning process followed by each student more or less to chance."

In opposition to mass instruction, the pendulum of emphasis is swinging back to individual instruction and independent study. The recent development of the teaching machine represents an important attempt to improve the efficiency of education and at the same time increase the teacher's control over the learning activities of each student in the classroom.

> Technical skills presently available in our society make it possible to implement certain psychological principles which have a profound effect on learning. Teaching machines represent one attempt to improve the efficiency of education by applying these principles to the teaching process (86:1).

Teaching machines differ from audio-visual devices in that each student activity participates in the learning situation and is given feedback in the form of knowledge of results; furthermore, the content to be learned is broken up into small sequential steps called a program. Teaching machines are a means of preserving the economical dissemination of knowledge and at the same time reinstate some of the advantages of face-to-face teaching methods.

According to Blyth (2:402) "the further development and rapid exploration of the teaching machine is one of the most promising approaches to the problems of teaching the increasingly complicated body of modern knowledge to even larger masses of people." Homme (19) and Edwards (118) refer to this latest technological application to education as ". . . the most important development . . . since intelligence tests." Lumsdaine (29:592) makes the claim that ". . . auto-instructional methods represent the most important innovation in education since the advent of the textbook."

Pressey (88) has been given the credit for the invention of the first teaching machine in which he attempted to embody the laws of learning as formulated in 1926. He seems to have been the first to emphasize the importance of immediate feedback in education, and his machine in contrast to the audio-visual aids that were beginning to be developed, permitted the student to play an active role. However, Pressey's work, according to Skinner (95:969) was succombed to cultural inertia because he ". . . was working against a background of psychological theory which had not come to grips with the learning process."

Pressey's idea was revived by B. F. Skinner. In his major article on teaching machines which appeared in 1958, Skinner claims that the learning process is now much better understood. He states that even though "much of what we know has come from studying the behavior of lower organisms . . . the results hold surprisingly well for human subjects" (95:970).

In 1954, Skinner laid the basis for his later development of the teaching machine idea when he wrote ". . . the advances which have recently been made in our control of the learning process suggest a thorough revision of classroom practices, and fortunately they tell us how the revision can be brought about" (94:93). The modern classroom, however, shows little evidence that the research on learning has been respected or used. To take advantage of recent advances in learning, teachers, must have the help of mechanical devices. Such devices, which implement in their design psychological principles of learning, permit more adequate reinforcement and more individual attention to be given to each student. They can also help to eliminate much of the tiresome and menial work of the teacher, such as paper grading and drill.

This research project is an exploration of the application of certain principles of learning, which are associated with teaching machine instruction, to filmstrip presentations in group situations.

General Statement of the Problem

The present study proposed in general (a) to use the revised version of the filmstrip produced by the Society for Visual Education which is entitled *Earth's Satellite: The Moon*; (b) to construct a verbal-pictorial test to measure as completely as possible the knowledge of the content of this filmstrip when used with select groups of fifth-sixth, seventh-eighth, and eleventh grade students; (c) to present the filmstrip and to test for learning according to three different methods: (1) frame-by-frame - when each frame of the filmstrip was followed by one or more test items over that frame, (2) sequence - when each logical unit of the filmstrip was followed by one or more test items over that sequence, and (3) whole - when the entire filmstrip was followed by all of the test items; (d) to vary the testing procedures during the three methods of filmstrip presentation so that one-half of the students would individually receive immediate knowledge of results - i.e., they would know, by how far the stylus went into the punchboard, whether or not the response was correct - and the other one-half of the students would receive no knowledge of their results at this time; (e) to repeat the test for the second time in all groups on the day following the filmstrip presentation and to give knowledge of results after each test item had been answered by the entire group; and (f) to measure the retention of the content taught by the filmstrip by repeating the criterion measure approximately three weeks after the filmstrip presentation.

Origin and Importance of the Study

In the fast-growing body of teaching machine research (programmed learning), reference is consistently made to the teaching machine device as having three main characteristics. The student is presented information usually in the form of a question by some means of display, the student is required to respond overtly, and the student is informed as to whether his answer is right or wrong. This last is called immediate knowledge of results.

It has been frequently stated that one of the chief advantages of automated instruction over the more standard instructional procedures stems from the immediacy of confirmation and frequency of reinforcement which the learner receives. It is also well established from the training of laboratory animals that reinforcement is most effective when administered as quickly as possible after a response has been made (94).

In a study conducted by VanderMeer (127) and supported by Title VII of the National Defense Education Act of 1958, filmstrip lessons were presented by two different methods. One method might be called immediate testing and the other method delayed testing. In the immediate testing schedule, students were tested over what was learned from each frame, immediately after it has been presented. In delayed testing, the entire filmstrip was presented without interruption, and the test covering the lesson was administered at the end of the presentation. Statistically significant differences were found favoring immediate testing when mean scores on the objective criterion test for the delayed testing group were compared with mean scores obtained by the immediate testing group. The superiority of immediate testing may be due to the fact that it embodies principles which relate to teaching machines. The findings concerning these techniques of presenting filmstrip lessons were a by-product of the above study by VanderMeer from which principles for improving filmstrips as teaching devices for class-size groups were developed.

The principal investigator of the present study, who was associated with VanderMeer during the latter's project, wishes to build upon VanderMeer's findings by making comparisons concerning the effectiveness of various techniques of presenting filmstrips and the effectiveness of immediate knowledge of test results as contrasted with delayed knowledge of results. The withholding of immediate knowledge of results in VanderMeer's study may have been a prominent factor in limiting the learning and retention of the content taught by the filmstrip. It is not known whether immediate testing will also result in a higher mean score for retention of the material presented by the filmstrip. It is possible that the continuity of the filmstrip is destroyed in immediate testing, thereby, actually hampering retention.

This investigation proposes to study the combined variables of immediate versus delayed knowledge of results. The findings will have implications for determining what method(s) used in presenting a filmstrip will achieve the greatest amount of factual and conceptual learning and retention (for group utilization) in a single showing. The author feels that in addition to further testing the findings of VanderMeer's investigation, this study may have relevance for research in programming filmstrips. One such study in programming filmstrips (129) is already under way.

Definition of Terms

"Question-to-Exhaustion" method: the technique used in preparing the multiple-choice test items for the criterion measure which consisted of writing every possible question that could be based on the narrative and/or pictorial content of the filmstrip, Earth's Satellite: The Moon.

Immediate knowledge of results: that is, each student knowing immediately, by how far the stylus went into the punchboard, whether or not the response he made to a test item was correct. Immediate knowledge of results was given during the treatment session to the experimental group only.

Delayed knowledge of results: that is, all students receiving information of the correct response from the investigator, who announced and pointed to the correct letter of the item on the screen and then underscored the answer as the students read it silently. Delayed knowledge of results was given to the students after each item had been responded to by everyone in the group. This procedure was followed in both the experimental and the control groups during the third session only, the delayed knowledge of results testing session.

Experimental group: (IK) those classes in grades five-six, seven-eight, and eleven which were randomly assigned to receive immediate knowledge of results along with one of the three different methods of filmstrip presentation during the treatment session.

Control group: (NK) those classes in grades five-six, seven-eight, and eleven which were randomly assigned to receive no knowledge of results in connection with one of the three different methods of filmstrip presentation during the treatment session.

Pre-treatment testing session: the session in which the students were acquainted with a punchboard device used for recording one's answers to the criterion measure. Two-by-two slides, practice exercises and test items were used, after which a science achievement test was given.

Treatment session: the session during which the filmstrip, Earth's Satellite: The Moon, was presented by one of three methods, all of which employed immediate knowledge of results for the experimental group and no knowledge of results for the control group.

Delayed knowledge of results testing session: the session held on the day immediately following the treatment session when the criterion measure was readministered and delayed knowledge of results was given to all groups.

Retention testing session: the session during which the criterion measure was given for the third time as a measure of retention.

Measure of retention: the resulting group mean scores on the criterion measure given 20 to 25 days following the (treatment session) filmstrip presentations.

Specific Statement of the Problem

The primary objective of this research was to study the effects of two degrees of immediacy of knowledge of results and three methods of presentation on the retention of knowledge contained in a filmstrip. The methods involved the presentation of a filmstrip on three different schedules. Either each frame of the filmstrip was followed by one or more test items, or each logical unit of the filmstrip was followed by one or more test items, or the entire filmstrip was followed by all of the test items. Half of the groups receiving each schedule knew if their response was correct immediately upon answering each test item; the other half of the subjects received knowledge of results on the day following the testing. The criterion measure of retention was the same objective test as used to measure the knowledge produced by the filmstrip presentation. It was administered approximately three weeks after the presentation of the filmstrips.

The following null hypotheses were tested in this study:

1. The frame and sequence methods of presenting a filmstrip are no more effective than the whole method for facilitating the learning or retention of the information contained in the filmstrip.
2. Knowledge of results is no more effective than no knowledge of results for facilitating the learning or retention of information presented by a filmstrip.
3. Grade level differences have no significant effect on the learning or retention of information presented by a filmstrip.
4. There is no significant interaction (which facilitates the learning or retention of information contained in a filmstrip) between any of the following combinations of variables: knowledge of results or no knowledge of results and methods of presenting a filmstrip -- frame, sequence, whole.
5. There is no significant interaction (which facilitates the learning or retention of information presented by a filmstrip) between any of the following combinations of variables: knowledge of results or no knowledge of results and grade levels -- five-six, seven-eight, eleven.

6. There is no significant interaction (which facilitates the learning or retention of information contained in a filmstrip) between any of the following combinations of variables: methods of presenting a filmstrip -- frame, sequence, whole and grade levels -- five-six, seven-eight, eleven.
7. There is no significant interaction (which facilitates the learning or retention of information contained in a filmstrip) between any of the following combinations of variables: knowledge of results or no knowledge of results, methods of presenting a filmstrip -- frame, sequence, whole and grade levels -- five-six, seven-eight, eleven.
8. Immediate testing does not reduce the retention of information learned by the students; therefore, the continuity of a filmstrip is not adversely affected.

Limitations of the Study

The following limitations were imposed on the reliability of the results reported in this present study.

1. Physical conditions, such as room darkness, ventilation and room temperature, types and arrangement of seating, and screen placement, under which the filmstrips were presented and the tests given, varied among the schools. These variations were relatively minor within grades seven-eight and eleven because only one junior high

school and one senior high school were involved. In the junior high school all sessions were conducted in the band room. In the senior high school, except for the delayed knowledge of results testing session when the group subjected to the frame method met in the audio-visual room and in the retention testing session when the groups subjected to the frame and sequence methods met in the choral room, all sessions were held in the auditorium. The variations were much greater for grade five-six since three different schools were involved. In two of these elementary schools different types of auditoriums were used and in the third the testing was done in a regular classroom. Thus the variations in the results of this present study which might be attributed to grade differences or to methods of presentation may not be as reliable as they could have been had all sessions been conducted under the same physical conditions.

2. Differences in results involving grade five and six might be attributed partially to the nature of the method used and partially to socio-economic factors, since each method was presented in a different elementary school. One of these schools was near the heart of the city, another several miles out, and the third still farther out of the city. Each school enrolled a somewhat different class of students.

3. A 20-item science achievement test on a related aspect in astronomy was given as the first step in this research to measure initial achievement in this field. The scores on this measure were used as one of the two control factors in the analysis of covariance program used in this present study. The reliability coefficient of

this measure was only .38 according to the Kuder-Richardson Formula 21 (16:455). This formula, however, tends to underestimate the reliability of a test.

4. A second control factor, intelligence quotients, may also have been a limitation since different intelligence tests were involved. In grades five-six and seven-eight the Lorge-Thorndike verbal scores were used and in grade eleven the Otis Beta general intelligence scores were used. These intelligence quotients were taken from the students' permanent records. The time between test results varied from less than six months for the sixth grade students to over two years for the eighth grade students.

5. Since students were presented the filmstrip and tested in group situations under paced conditions, tight control over each student's behavior as he responded to the items was not possible as in an individualized, tutorial, or teaching machine approach.

6. Exposure of the students to four sessions, three of which were to the same test materials, may have influenced their behavior in part of the study. Restlessness and frustration were evident in the delayed knowledge of results testing session; and in the retention testing session, exposure to the criterion measure for the third time may have resulted in indifference on the part of some of the students. Besides, the material could have been discussed by the students between the treatment session, delayed knowledge of results session, and the retention session.

7. Even though the variables of this investigation are meaningful for many classroom situations and would be under the control

of the classroom teacher, general implications drawn from the findings of the present study will be subject to limitations resulting from the fact that the concepts were taught by filmstrip presentations and were restricted in content to physical science.

Chapter II

REVIEW OF THE LITERATURE

Five (13, 17, 26, 35, 93) extensive summaries of research investigations were reviewed in addition to Moldstad's (80) listing of "Doctoral Dissertations in Audio-Visual Education," Dissertation Abstracts from January, 1958, to May, 1963, and five installments of "Title VII Research Abstracts" (45). No studies were found which were comparable to the present one. However, there were studies in three major areas (psychology, film research, and teaching machine research) relating to the two key variables in this study which are (1) knowledge of results and (2) part versus whole dissemination of information.

Introduction to Knowledge of Results

According to B. F. Skinner (94:91) "perhaps the most serious criticism of the current classroom is the relative infrequency of reinforcement." He claims that a teacher cannot possibly give adequate amounts of reinforcement. In the typical classroom a student has infrequent occasions for responding and receiving reinforcements. On examinations reinforcements are delayed and non-specific.

> Differentials in the modes of reinforcement of learning constitute . . . [an] area of knowledge which is a vital element in the educational foundation of the general audio-visual specialist. Among these modes and principles of reinforcement . . . [is] the learner's knowledge of results. . . . [This element will affect] the manner in which information is presented through audio-visual materials (100:46).

As far back as 1946 Mark A. May (77) reported research on experimental motion pictures that were designed and produced to examine certain psychological theories. During the past few years the question of how learning theories may be applied to the use of audio-visual materials has been increasingly pondered by educators, psychologists, and audio-visual researchers. Graphic Communication and the Crisis in Education (33:102) summarizes many of the important conclusions. This book, which was prepared as a result of conferences held at the Yale University Institute of Human Relations in 1953 and 1954, advocates that "attempts should be made to discover yet other solutions to the problem of immediately rewarding correct responses to audio and visual materials." More recently Postman, in concluding his article on "Human Learning and Audio-Visual Education," makes the statement that

> . . . the analysis of the process of audiovisual education does not call for the formulation of special principles; it calls for the application and elaboration of the general laws of human learning (87:78).
>
> . . . [This] sentence . . . might well serve as a motto for research upon audiovisual devices . . . . Certainly this is the assumption that has gone into much of the modern work on teaching machines . . . (59:86).

Recently more attention has been given to the theory of learning as a basis for more effective use of audio-visual materials. From the research dealing with various characteristics of learning has come insight into how more effective organization and presentation of materials might be devised.

In helping to bridge the gap between what is known about learning in the laboratory and learning in practical situations, Gagne and Bolles reviewed the principles derived from laboratory findings which seem relevant to the problem of promoting learning efficiency. Regarding the state of knowledge at that time for the variable of reinforcement, they reported that "at present, there seems to be no contrary evidence to the general conclusion that learning is facilitated by frequent, immediate, and positive reinforcement" (14:29).

Porter (85) warns that caution should be exercised in generalizing the results of research from the experimental laboratory to the classroom or from one species to another even though Skinner (94:89) claims that "comparable results have been obtained with pigeons, rats, dogs, monkeys, [and] human children. . . ."

> Despite the voluminous literature on the effects of reinforcement and variations in its scheduling on learning by infrahuman species, relatively few studies have experimentally manipulated reinforcement factors as they operate in practical instruction. In general, differences in the ways that knowledge of results functions have not been clearly analyzed either, particularly in verbal learning (29:619).

Introduction to Part Versus Whole Learning

Practically any subject can be studied as a whole or can be divided into parts of various sizes. By dividing the material into parts the amount to be understood at one gulp is reduced, thus, making the total task less overwhelming. Many times students are confronted with arbitrary divisions of subject matter without opportunity to view the total structure or to understand the function of a particular segment in relation to the whole. Often there are advantages in taking up large units or wholes from the beginning.

Understanding of the whole gives meaning to the parts which makes the parts easier to learn. More than likely the most effective means of presenting the program will vary as a result of the type and amount of subject matter to be learned.

Skinner (94) believes the subject should be broken down into a number of parts or "steps" which should be so small that practically no errors will occur in learning. Lumsdaine believes that this ". . . technique for the optimal sequencing of material developed in the context of self-instructional materials can be applied in improving the content and sequencing of instruction presented to large groups by the mass media" (74:62).

In pointing up the values of the small-step approach, Holland (18), an associate of Skinner's, found that when the material was so difficult that the students made many errors, they became irritated, almost aggressive, and finally stopped work as a result. Ferster and Sapon (61) also discovered that when the level of difficulty increased too rapidly from unit to unit, so that large numbers of errors were made, students reported that they were emotionally upset and had a strong urge to stop even though they may not have completed all of the work.

> The important principle that mastery of a complex subject should be built up by fairly small steps is a deceptively simple one, even though its essential soundness for many purposes may be taken more or less for granted (27:531).

Pressey (90) believes that the fragmentation of subject matter called programming is of limited value and that teaching machines do not need to involve the cutting up of what is to be learned into many little steps.

It has been recommended that the optional step size should be determined objectively by varying different sized steps in experimental programs. Thus different sequences should be constructed to teach the same concept with varying numbers of steps (15). For this study the term "size of step" may be best described as "size of frame" i.e., ". . . the interval between successive questions to which the learner is asked to respond. In effect, here we have deliberate incomplete programming in which several steps are combined into a single step" (27:533).

Psychology

In discussing the relationship of learning theory to the technology of education, Spence (96) points out that the psychologist has been asked to solve practical problems related to teaching before they have adequately formulated the laws of behavior to do so. Carpenter elaborates on this problem as follows.

> To present in an integrated or even an orderly manner the varied contemporary learning and communication theories as they relate to the educational uses of the new media is extraordinarily difficult. Actually such an effort may be premature, for first we must have vastly more evidence than we now have on learning. The theories, hypotheses, and proven principles must be better organized and integrated into meaningful, coherent, and logical systems. The generality of the theories and principles should be operationally tested, especially as they apply to complex communicative processes and to the methods, procedures, and techniques of academic learning and teaching. The critical need for these developments has not produced them (50:297).

Knowledge of Results

The primary principle lying behind the recent widespread use of teaching machines is what Skinner refers to as the principle of reinforcement. This principle is based on the one law that has consistently held true in all experimental studies of learning, i.e., the law of effect. This law states that

> . . . responses accompanied or followed by certain kinds of events (called reinforcers) are more likely to occur on subsequent occasions, whereas responses not followed by this class of events subsequently show a lessened probability of occurrence (96:93).

The law of effect was first systematically investigated by Thorndike in 1927. In this classical study, seven blindfolded subjects were asked to draw a line four inches long. After 400 trials with no knowledge of results their errors averaged practically the same as they did at the beginning. They were then given 25 more trials with an opportunity after each trial to open their eyes and check the line they had drawn. In only four trials they were able to reduce their error to 3/16 of an inch (21).

In a repetition of one of Thorndike's line drawings experiments, Trowbridge and Cason (99) demonstrate the importance of giving a subject specific and immediate information concerning the outcome of his efforts. Subjects who attempted to draw a three-inch line without knowledge of results made no improvement in 100 attempts. Those who were simply told that each trial was right or wrong made some improvement. Those who were given the amount and direction of their errors after each trial improved even more.

Arps (47, 48) conducted one of the earliest studies dealing with knowledge of results. In this study the subject was to lift a nine-pound weight by the flexing of his middle finger. His movements were recorded on the moving paper of the kymograph, thus, giving visible results which were helpful in increasing the subject's output and attention and in the resisting of fatigue.

Knowledge of results is also easily observed in the familiar mirror-drawing experiment (58) in which the beginner must wait for results before correcting his errors, whereas, a skilled person adjusts automatically. "It has been known for a long time that performance will not improve unless the individual knows whether what he does is right or wrong and what errors he makes" (37:76).

In 1929 a study by Curtis and Woods (57) indicated that the grading method in which the students checked the incorrect items on their own objective tests during a discussion of the test items was more profitable than the other methods in which the teacher graded the test papers for the student.

More recently, this concept of knowledge of results has been taken most seriously in the development of teaching machines and programmed learning where reinforcement is forthcoming upon the completion of the student's response. "The utilization of this fact of learning in educational technology is very dramatic in light of the frequent delay of reinforcement that occurs in many classroom procedures" (65:48). In many classrooms knowledge of results may be delayed for minutes, hours, or even days following the occurrence of a response to a problem situation.

McGeoch and Irion (30:268) in their book, The Psychology of Human Learning, report "the conclusion, derived from the general principles of learning, is that, for most efficient learning, knowledge of results should be administered as quickly and as specifically as possible." Skinner (94) states that it can be easily demonstrated that the lapse of only a few seconds between response and reinforcement destroys most of the effect. Saltzman's study (92) shows that a delay of six seconds in knowledge of results resulted in a fifty percent increase in errors when learning a rote verbal task.

> It is possible that increasing the amount of material to be learned might appreciably increase the effect of delay of confirmation upon learning time. . . [; therefore,] additional research on the relations between delay of confirmations and learning time seems badly needed (5:546). [Also] being shown the correct answer or selecting the correct answer after several tries does not insure . . . that the student has actually acquired the necessary knowledge (7:454).

Many psychologists and educators have accepted the fact that immediacy is important in giving knowledge of results, and certainly this fact is borne out by many laboratory studies on animal behavior as cited in the Encyclopedia of Educational Research (17:758). Disagreement, however, shows up in the theoretical interpretations of these consistent empirical findings.

> Apparently the fact that Thorndike, who played such an important role in originating animal experimentation with learning situations, subsequently went into the field of educational psychology, has led many psychologists to jump to the conclusion that all studies of animal learning must have been undertaken with a view to finding principles of use to educational psychology and other areas of practical application (96:86).

It is unfortunate that little has been done to study the phenomenon of reinforcement with human subjects even though delay of reinforcement in everyday life situations may be of greater significance than in the laboratory. In one study which varied reinforcement from no delay to a delay of one and one-half hours, the children who received immediate reinforcement did not do better than those who received delayed reinforcement. It is not known, however, if a non-reinforced group would have shown as much improvement as the reinforced group since no control group was included (49).

Part Versus Whole Learning

There seems to be no universal agreement on the part or the whole methods of learning. A number of conditions appear to determine the relative advantage of each. A number of early studies beginning with Steffens (97) showed that the whole method was more effective than the part method; whereas, other studies beginning with Pechstein (82) found the part method more effective. The results of a later study on acquisition in serial learning by Hanawalt (67) has been given greater credence since her experimental control was superior. Hanawalt's results showed the whole method to be most efficient, the intermediate part method to be next, and the pure part method to be least efficient for acquisition.

Meaning and organization favor the whole method but the principle of reinforcement favors part learning. The part is a quickly attainable goal which affords satisfaction and encouragement; whereas, the whole method requires much more time and work before any results of learning are manifested.

> Research shows that at times fairly large units can be learned best but that at other times one learns better if he nibbles off one small segment at a time. The use of larger units is favored if the parts are understood by the learner. The whole has no advantage unless the student sees the meaningful relations within it. . . . the proper whole is guarded by the readiness of the pupils, as well as by the subject matter (8:307, 308).

There appears to be an optional length or size of unit which determines whether the whole method or the part method is superior (56, 123). Individual differences due to age and level of mental development (75, 82, 91) as well as practice (with the whole method) (56, 71, 97) are also determining factors to be considered in judging which method is superior.

Hovland (21:650) reports several studies which found that material learned by the whole method was better retained than that learned by the part method. It appears, therefore, that under the right conditions the superiority of the whole method can hardly be questioned. In actual practice, however, one can seldom bring together all the conditions that make this method superior to the part method (23).

Film Research

Very little research dealing with the proper utilization of filmstrips has been done. This research has been limited in its scope because it has largely been an attempt to show that the filmstrip may be used as effectively as the more expensive motion picture film. Lumsdaine suggests that both films and filmstrips, even though they are group-instructional techniques, can offer many of the advantages of an individual teaching machine. Among these advantages are provision for active response and correction-feedback. Group instructional aids are essentially one-way, passive-reception in character because no provision is made for these variables. He suggests that there are many possibilities of application of automated teaching techniques to group-instructional situations.

> Such automated group instructional techniques, using alternated presentation, question and response, have much in common with individual teaching machines. [These techniques] . . . can be and have been achieved in varying degrees with certain special kinds of group-presented films . . . that provide for frequent interspersing of questions or practice segments and presentation (24:148).

Lumsdaine feels that further research on variables that govern the effectiveness of group-instructional techniques can have direct relevance to the design of teaching machines and teaching machine programs. Allen (43), in his review of film research, cites a number of studies which have bearing on this study.

Knowledge of Results

Four studies (72, 101, 108, 109) reported that one of the most effective ways of increasing learning is to insert participation questions into existing films followed by the giving of knowledge of correct responses. Although the results of Kurtz *et al*., study (108) was inconclusive, the Yale University, Michael, and Levine studies showed superior informational gains as a result of the participation method.

In the Yale University study (101) a film on the heart and circulatory system was used. After the presentation of each unit of film material, a title in the film directed the students to answer certain questions contained on a worksheet. Shortly afterward, the correct answer was shown on the screen. Thus the students were informed immediately whether their answers were right or wrong.

In Michael's study (109), a film on civil defense against the atomic bomb was stopped periodically and the audience was asked questions on what they had seen. Feedback or knowledge of the correct answer to the questions asked in the film was the most important (highly significant) single factor in the study.

The results of a study by Kantor (69) differed from those suggested by the previous researchers. Kantor hypothesized that inserting questions, which are both visual and oral, in an instructional film would raise its teaching effectiveness. One film version had questions inserted at natural divisions of the content. Two other versions inserted questions either before or after the cqntent in the film. Visually the questions were in keeping with the quality of the film and the narrator for the questions was the same as for the content. No significant differences, however, were found in the film versions on the post-test or the retention test (5 weeks). All versions taught equally well.

Instead of interspersing test items with knowledge of correct responses during a film showing, Hirsch (106) gave knowledge of results during a test immediately following the film presentation. Several methods of presenting knowledge of results were tested, using the classroom communicator, a device developed by the Instructional Film Research Project at The Pennsylvania State University, to enable immediate and continuous communication between the instructor and any student in the class. Hirsch found that knowledge of test results had a significant effect upon learning and retention (3 weeks), particularly when the entire question and answer was provided. Showing the film twice, however, appeared to be about as effective as using knowledge of test results with only one showing.

Hall (66) found no significant differences in retention between a group which was tested immediately following a film presentation and one which was tested during the presentation. Testing during the film presentation involved the projection of slides containing the test items below the film. Students were to write the answers as soon as they could. Both groups showed significant gains in learning even when they were retested after two weeks.

Significantly greater learning and retention (1 week) also occurred when a pre-film test, with identical, sequentially ordered items employing immediate knowledge of results by means of a punchboard device, immediately preceded the showing of a film (110).

Kurpiewski (120) used the classroom communicator to facilitate learning and retention of material presented in a series of six lectures. The control group was tested in the conventional manner of answering questions at the end of the lecture series. One experimental group had 8-9 questions projected on a screen at the end of each lecture. Another group received the projected questions during the course of each lecture after small units of work were presented.

These two experimental groups used answer sheets to record their answers. The third experimental group used the classroom communicator to record their answers to the projected questions during the course of each lecture after small units were presented. All three experimental groups were superior to the control group on the retention test (9 days). There were no significant differences, however, in the results between the experimental groups.

In using slides to teach aviation trainees to identify twenty foreign airplanes, Gibson (104) investigated the effectiveness of differences in two methods of immediate reinforcement in a learner participation experiment. In one method an announcement of the name of the plane was made by the instructor before each of the first three projections. On the fourth projection the trainees were required to furnish the identification. The other method provided for trainee response on the second and third trials and subsequent knowledge of the correctness of the response as the slides were repeated for the fourth time. Those who were instructed with reinforced practice were more than 40 per cent superior to those taught by the unreinforced method.

Hovland, Lumsdaine, and Sheffield (20) used two forms of a film to teach military phonetic alphabet (A for able, B for baker, etc.). The purpose of this study was to study the effect of active student response or audience participation procedures during review sequences. In one film version, feedback-correction was provided by the fact that the group had to call out each response aloud. Since someone nearly always gave the correct response, correction was thereby provided. This active-response procedure was significantly superior to the control procedure.

Knowledge of results in the form of pointing out errors to students involved in learning tumbling skills by means of film loops also resulted in greater learning according to Harby (105).

Part Versus Whole Learning

One of the few pieces of solid experimental evidence giving analytical treatment to variations in length of step comes from the experiments of Maccoby, Sheffield, and Margolius.

Maccoby and Sheffield (31) experimentally manipulated conditions which affected the probability of a correct response during the learning of sequential procedures from a film demonstration in conjunction with practice of each procedure. The length of the sequence which was demonstrated before each practice period affected the probability of a correct response. The poorest performance resulted when the entire task was demonstrated before being practiced. This finding held true on both the practice tests and on later tests. The best performance occurred when the demonstration of a short segment was followed by practice of only that segment, before presentation of the next part. Thus small steps led to high probability of students responding correctly, and gave better results than larger steps.

Margolius and Sheffield (32) also found that the poorest results in terms of performance rate were found with the whole method of practice.

Teaching Machine and Programmed Learning Research

Only six articles on teaching machines and programmed instruction appeared before 1948 and only 35 studies were reported between 1948 and 1958. In 1958 the explosion of interest began with 37 studies reported (59 in 1959) and since continues unabated.

Programmed instruction breaks down the subject matter into small units and arranges them in a sequence which is carefully tested and thought to be an effective learning pattern. The presentation of information is accompanied with questions. The most significant factor is the knowledge of results with which each student is immediately furnished upon answering each question (36).

Knowledge of Results

Fry believes that since knowledge of results is relatively inexpensive and easily administered there is little point in withholding it, especially since there are good psychological grounds for granting it immediately.

> Laboratory studies are unequivocal in emphasizing the importance of giving a subject as specific and as immediate information as possible concerning the outcome of his efforts [and] if the sheer weight of authority is conclusive, then the point is beyond question (12:157).

If, however, knowledge of results is to contribute significantly to learning, it should be systematic and applied in a meaningful or intentional manner. Freeman (62) bears this fact out as well as showing that the casual use of reinforcement has little effect on performance.

Porter (85:134) claims "the designers of immediate reinforcer teaching devices have made certain assumptions, however, which are not well documented." For example Holland (18:218) reports that ". . . with humans, simply being correct is sufficient reinforcement." Pressey (89) and Skinner (94) also claim that teaching machines are effective because they provide immediate reinforcement. Skinner implies in his writing that the most common and effective way of providing reinforcement for the learner is to tell him that the response he made was the correct one. Travers (37) and Geis (64) question the soundness of this position and contend that reinforcement may be an individual matter. Porter thinks that the results obtained thus far do not provide a basis for making the claim that they are due to immediacy of reinforcement. If this is so, considerable limitations are placed on the value of teaching machines since knowledge of results is assumed to be a powerful reinforcer in the use of all teaching machines. Much more must be known about reinforcement if teaching machines are to be viewed with more than speculation.

In 1957 Porter reported in his critical review of the literature on teaching devices that only four experimental studies had been published on immediate reinforcer teaching devices. Therefore, to gain substantial support for the belief that the rate of learning is a function of temporal delay between a learner's response and confirmation, one had to go outside the context of research on automated instruction.

Of the studies reported by Porter, three were concerned with punchboards (46, 73, 89), one with chemical paper (84), and one with a Pressey answer key device (73). Little's study (73) was the first systematic study using teaching machines as part of the regular routine in university classes. Two of Pressey's multiple-choice teaching devices were compared using students in Educational Psychology classes. The results indicated that the students who gained immediate knowledge of test results during the semester using these devices scored higher on objective and essay final examinations than the students whose papers were scored by the instructor and returned on the following day.

The purpose of the study by Angell and Troyer (46) was to determine the effect of immediate and delayed knowledge of quiz results on three types of learning in freshman chemistry. IBM answer sheets were used by the control group receiving delayed knowledge of results. Their papers were scored and returned to the students at the meeting following the taking of each quiz. Punchboards were used by the experimental group. The criterion of improvement was the scores on a final examination.

Pressey's major study in 1950 (89) was one of the largest that had been done. It centered largely on the use of the punchboard device. Students in educational psychology at the Ohio State University found the punchboards a simple way of taking and scoring a test. The students were also guided in finding the right answers by being informed of their errors. Students knew immediately, exactly which questions were wrong, not just that they had scored a certain percentage on the total test. In the words of Pressey, ". . . the device not only tests, it also teaches."

These experiments attempted to compare the results of the device with "usual" classroom teaching. All claimed their devices were superior due to "knowledge of results." Porter claims that the outcomes favoring these devices might have been influenced by what is considered to be "usual" classroom teaching and by the experimental procedures followed. It is also likely that the control subjects did not have their test results reviewed with them in class by the teachers, and consequently they received no information concerning their own lack of knowledge.

Therefore, Porter suggests a need for further study of the value of immediate knowledge of results and suggests they meet the following, so far unattained, criteria: (1) Provide the experimental and control group with knowledge of results, i.e., make sure both groups receive equivalent information about the correctness of their responses, (2) In the control group, delay reinforcement, and (3) In the experimental group, reinforce as quickly as possible. "It seems clear . . . that the nature of the reinforcement employed in self-instructional devices has not yet been carefully analyzed, let alone adequately studied" (5:549). Seemingly, we have done a much better job of applying this principle in teaching rats and pigeons than we have in teaching mathematicians and physicists.

In a doctoral study analyzing the effects of knowledge of results, Briggs (113) found the scores of the experimental group which used a punchboard device to be significantly superior (.01) to those obtained by the control group which used regular test procedures in which no knowledge of results was given. One punchboard group was allowed only one try per item; whereas, a second punchboard group was allowed to work on each item until the correct answer was found. The results of the second punchboard group were superior to those of the first group. A similar result was obtained by Bryan and Rigney (102) when they found that explanation of choices was significantly more effective than no knowledge of results or even than a mere indication of right or wrong.

In another doctoral study the effectiveness of several ways of using a program of 19 lessons for teaching Latin prefixes was tested. The lessons were presented to 44 eighth graders by means of a programmed text. The responses for the "delayed-effect" group were corrected between lesson sessions by the experimenter. In the "immediate-effect" group each individual scored his own responses during the lesson. The results were as follows.

> The number of errors committed in the programmed textbook by the Delayed-effect group was significantly greater than that committed by the Immediate-effect group. The gain in points from pre-test to post-test made by the Delayed-effect group was significantly below the gain by the Immediate-effect group. The hypothesis that immediate confirmation of correct responses and dis-confirmation of incorrect responses would lead to superior acquisition was supported by the data (122:4730).

A teaching machine was used in a study by Keislar (70) to teach understanding of elementary arithmetic, i.e., the ability to answer a variety of questions different from those encountered during training but belonging to the same general class. The test items in filmstrip form were projected on a viewing plate in front of the learner who in turn responded by pressing one of five buttons. If he responded correctly a green light appeared and the next item could be brought into view; if wrong, a red light appeared. A special device recorded on a graph all errors and correct responses. The program consisted of 120 items, ten of which were practice items in operating the machine. There were 14 experimental subjects from the fourth and fifth grade matched with 14 control subjects on the basis of a pre-test. On the whole, the experimental group scored significantly better (.01) than the control group.

In a study by Briggs and Besnard (4) a portion of an Air Force maintenance course was taught to two groups of students. One group was taught by "appropriate" conventional instructor-presented methods. The other group devoted a considerable portion of their training time to reinforced practice, utilizing the Subject Matter Trainer. An analysis of proficiency performance scores showed that the performance of the experimental group was significantly higher than that of the control group. There were no significant differences, however, between the two treatments in terms of written tests even though they correlated positively with the performance test.

Irion and Briggs (107) in experimenting with various modes of using the Subject Matter Trainer found the quiz mode to be the most effective. In the quiz mode a student presses a button which always shows the right answer; he then presses another button which causes the machine to proceed to the next item. One reason accounting for the superiority of the quiz mode is the close temporal continuity between the presentation of the stimulus and the appearance of the right response.

Studies by Cook and Kendler (6) and Cook (53) show that *prompting*, i.e., stimulus term, then response term, then overt practice of the response term, is superior to *confirmation*, i.e., stimulus term, overt practice, and then the response term. A further study by Cook and Spitzer (54) confirms that the superiority of prompting is due to a shorter between-term delay.

Programmed instruction may be unattractive to the more capable student, according to the results of a teaching machine demonstration at the Indiana State Fair. D. L. Cook (52) found that as the degree of reinforcement was increased the attitude of college educated persons became more negative toward programmed instruction; whereas, the attitude of persons with only an eighth grade education became more positive. The results from two other studies seem to indicate that knowledge of results might also be of little value for small units or short, relatively easy tasks (1, 124).

The results of several recent studies differ from the results of those studies cited previously in this chapter. These conflicting findings suggest that perhaps more investigation of the effect of knowledge of results on learning is needed. One such study by Row (34) investigated several automated teaching methods involving linear programs. Due to the programming aspect, all automated methods proved to be significantly better in achievement than the standard lecture method. The use of programmed texts with overt responses and the giving of correct answers, however, did not prove to significantly increase learning.

Feldhusen and Birt (60) also found no significant differences in learning between students who used a conventional linear, constructed response program which gave reinforcement and those who learned by the same program without knowledge of results.

Moore and Smith (81) tested the effectiveness of giving the learner immediate knowledge of results when teaching spelling to sixth graders. One unit of programmed spelling was taught each week for fifteen weeks after which the experiment was repeated. The results of both experiments revealed that there were no significant differences between the mean achievement of students who received reinforcement and the mean achievement of those who did not receive it.

On the college level, Hough and Revsin (68) sought to investigate whether immediate knowledge as to the correctness of a response produces more learning than responding without knowledge of results. A linear, selected response program was used with 90 students in secondary education at Temple University. Program instruction involved three weeks out of the semester and dealt with the historic foundations of the secondary school. The results reveal that it made no difference whether the students received reinforcement in the form of knowledge of results since no significant differences could be found in learning.

> Our "no difference" findings in regard to the effect of reinforcement versus no reinforcement are supported by . . . previous studies. However, considerable caution must be exercised in interpreting the findings reported in this study. The program used . . . is a low error rate program. When students "know" that their response is right and thus assumedly reinforce themselves, it would seem reasonable that further confirmation in the form of a reinforcement frame would be redundant (68:290).

Part Versus Whole Learning

The heart of the auto-instructional approach is the teaching machine program. Such a program carefully organizes the subject matter into a logical sequence which is in turn broken down into small, discrete steps or questions. Each step deliberately builds upon the preceding steps. According to Lumsdaine, the ". . . 'size of step' may refer to the difficulty (and hence probable correctness) of giving a correct response to any item. Also, it may refer to the concepts, relationships, or terminology between successive steps or sets of steps in a program" (27).

Skinner and Keislar among others advocate that the step from one item to the next in a sequence should be so small that the learner will almost always answer each item correctly. Coulson and Silberman (7, 51) and Evans, Glaser, and Homme (11) found that smaller steps resulted in better learning and took less time per step than large steps.

Most teaching machines have one inflexible characteristic in common, that is, each student is presented the same sequence of items regardless of his individual capacities or limitations. The basic assumption underlying this design is that a single sequence of items can be optimumly effective for a number of students. However, when viewed in the context of the typical classroom this assumption seems highly doubtful. Individual differences would appear to make an ideal sequence of items for one student less than maximally effective for some other student.

A study undertaken by Coulson and Silberman (7, 51) explored the effectiveness of "foreward branching," i.e., students who answered correctly were not shown other items on that topic, as compared with a fixed-sequence mode. Thus the exact number and sequence of items in the branching mode depended on the performance of each subject. Another variable tested was the small-step program versus the large-step program. Supposedly the program containing many items required less effort on the part of the subject to answer successive items than a program containing fewer items. Eight groups of 10 junior-college students were given a portion of a college course in elementary psychology used at Harvard University. All of the groups used manually simulated teaching machines, but a different mode of teaching machine operation was used to present the program to each group. The criterion test was given to all subjects immediately after the presentation session and again three weeks later. A 104-member control group came from the same psychology class. They were given the same criterion test although they received no training with the teaching machine. Pre-test scores were used as a control variable in a covariance design. The subjects in the experimental group learned significantly more than the subjects in the control group and the concepts taught by means of the simulated teaching machines were retained at least for a three-week period. In line with B. F. Skinner's emphasis on small-item steps, the results of this study yielded significantly higher test scores for those groups given more test items (small steps). In view of this finding, it is notable that foreward branching (reducing the total number of items presented) did not differ significantly from the fixed sequence or non-branching mode in the amount taught.

Evans, Glaser, and Homme (11) in their study varied the number of steps required to go through programmed lessons on number theory and music fundamentals. Although less time per step was required by the small step program, more total time was involved. Significantly fewer errors on immediate and delayed performance tests were also associated with smaller steps as well as fewer response errors in the course of learning. There appears to be a limit, however, beyond which increasing the number of steps in a sequence does not result in improved performance.

The principles of programming have also been applied to television instruction by Cropper and Lumsdaine (116, 117). In comparing the effectiveness of programmed TV lessons encouraging active student response, with conventional TV lessons, learning and retention (2 weeks) were found significantly more effective for those students making active responses during the programmed lesson. Thus it was concluded that methods employed to insure that the student is capable of making correct responses adds to the effectiveness of instruction and that little basis exists for believing that learning is enhanced by merely requiring students to make active responses, without employing programming techniques.

In a study by Campbell (114) it was reported by some subjects that fragmentation of the material into small physically separated steps disrupted their continuity of thought. A similar result was reported by Weiss, Maccoby, and Sheffield (38) who claimed that practicing a task exclusively in small segments will detract from the integration of the task as a whole. Although the small unit method maximizes correct performance during practice, they claim that if the different parts of the total task are to be successfully connected together, then at least some practice at larger units of the task may be desirable even if it entails more errors in performance at the onset of practice.

The results of a study conducted to determine the similarity among learner-generated instructional sequences indicated that the sequence of instruction which the instructor considers to be meaningful is different from that which the student considers to be meaningful. Generally, the learner proceeds from the whole to the part while the instructor proceeds from the part to the whole (76).

Smith and Moore (125) compared the effects of three sizes of steps on achievement in programmed spelling. One hundred sixty-four words most frequently included in thirteen sixth grade spellers were divided into eight units and programmed into small, medium, and large steps. Ninety-six fifth grade students, matched on the basis of sex, were randomly assigned to six groups. They were pre-tested the day before the experimental period (4 weeks) and post-tested the day afterward. By analysis of variance it was found that all methods employed for teaching spelling proved equally effective. It was concluded that since the large-step program was as effective as the small-step version and required less time, programs using very small steps are not necessarily desirable. It was also concluded that if the students consider the very small steps unnecessarily repititious then the additional hazard of a possible loss of interest in the material is an undesirable by-product. No significant differences were also found in two different studies which compared the effectiveness of random versus sequential or logical presentations of material (61, 111).

This conflicting evidence makes one wonder if the variables tested really have little effect on learning or whether they have not been adequately studied.

> It is evident from the preceding examples that resolution of the question of "size of step" and number of steps to be used is an instructional sequence involves factors which need to be disentangled. Not only more experimentation, but also better formulation of factors and hypothesis, is needed to permit precise statements about the advantages of "proceeding by small steps" in automated learning programs for verbal learning (29:627).

Chapter III

PROCEDURES

Selection of the Filmstrip and Test Validation

The revised version of the black and white filmstrip entitled *Earth's Satellite: The Moon* was used in this study. It is from the Society of Visual Education series on *Earth and the Universe* for grades 5-12. This revision was made after establishing a "learning profile" by analyzing the weakness and strengths of the original filmstrip derived from an analysis of the proportions passing individual test items or clusters of items as they related to logical units of the filmstrip. On the basis of a comparison made between total mean scores on tests taken after a single presentation (without comment) of the original and revised filmstrips, the revised version proved to produce higher mean scores than the original version at an acceptable level of statistical significance (128). Since this study proposed to build VanderMeer's work (127), the revised version of the filmstrip by VanderMeer and Montgomery was used.

The "question-to-exhaustion" method was employed in constructing the 80 multiple-choice items used as the criterion measure. In some test items, actual photographs and drawings from frames of the filmstrip and a number of other line drawings were used to test pictorial material. After reviewing the items for good form and submitting them to a content analysis, they were administered on September 13, 14, and September 22, 1960, to 152 pupils in the Coatesville (Pennsylvania) city schools -- 48 from grade five, 60 from grade eight, and 44 from grades ten and eleven. After administering the test, the technique of item analysis was used for validation. The basic analysis consisted of a tabulation of the number and the percentage of students which answered each item correctly and how many chose each of the possible responses. It was possible to infer from this tabulation how difficult the item was and whether all the options attracted responses. Items were also examined from the viewpoint of the proportions of the upper 27% of the group selecting each response as compared to the proportions selecting each response in the lower 27% in terms of total scores on the criterion test. It was determined from this analysis if the item was discriminating favorably between the better and poorer students. The combined data from grades five, eight, and ten and eleven was reviewed in light of these responses and was utilized in improving the testing instrument. Questions which were found to be poorly constructed or ambiguous as a result of this item analysis were revised. Further improvements in the items were made using a second item analysis of the test based on the revised version of the filmstrip. The reliability of the 80-item criterion measure used in the treatment session, delayed knowledge of results testing session, and the retention testing session was estimated by using the Kuder-Richardson Formula 21 for determining the internal consistency of a test (16:455). The reliability coefficients obtained were as follows: .91 for the treatment session, .91 for the delayed knowledge of results testing session, and .89 for the retention testing session. A copy of the criterion measure appears in Appendix B.

Preparation of the Filmstrip Test

On November 6, 1961, a production conference was held at the Society for Visual Education in Chicago, Illinois. Participating with the writer were Mr. Paul Rosenau, Director of Special Services and Mr. Winfield Nash, staff artist. The object of the conference was to plan the production of the 80-item test in filmstrip form. Care was taken to insure that the composition and format of the test filmstrip would be like that of Earth's Satellite: The Moon. For example, items using line drawings, that had been drawn free hand for the original test which was in booklet form, were drawn by the staff artist to look like the symbols actually used in the filmstrip. Art or photographic work taken directly from the filmstrip was used in other items. The type size and face used in each item in the filmstrip test was identical to that used in the original filmstrip. Also, the same production process was used in producing the 80-item test in filmstrip form.

Since it was not possible to produce combined filmstrip and question materials for each method, they were produced separately, cut up and mounted into single frame slide mounts, and then arranged according to each method of presentation. Thus the quality of the three slide presentations may not be equivalent to the filmstrip form of presentations. Another set of the same filmstrip questions with the answers marked in some way, which could have followed the unmarked questions which the students responded to, might have been a better technique for giving delayed knowledge of results than using a pointer light to point out and underscore the correct response as it was read silently by the students. These limitations in form were due to insufficient funds for production.

Arrangement for the Methods of Filmstrip Presentation

The frames of the filmstrips mounted in single-frame slide mounts were pre-arranged and stored in slide trays according to the three different methods of presentation used in this study. The Argus electromatic model 570 automatic slide projector with remote controls and built-in pointer was used for projection of the slide series for each method. There were three versions of a 114 frame filmstrip containing 34 information-conveying frames and 80 test frames. The methods of presentation reflected differences in the manner of arrangement of the information frames and the test frames. Following is a description of the arrangement used for each method.

1. The Frame Method

Each frame of the filmstrip was followed by one or more test items based on pictorial and narrative information contained in that frame. There were 34 frames in the filmstrip and 80 items in the test. The number of items following each frame ranged from one to seven with a median of two items per frame.

2. The Sequence Method

The frames of the filmstrip were arranged according to logical units of subject matter content by the investigator. The "sequences" were then verified by the other collaborators involved in this present study. Table 57 in Appendix A contains a summary of the number of information-frames and question-frames per sequence. There were eleven different sequences ranging from one to six frames each. The median number of frames per sequence was three. The number of test items covering the pictorial and narrative information contained in the frames of each sequence ranged from one to eighteen with a median number of seven items per sequence.

3. The Whole Method

This method consisted of the presentation of the entire 34 frames of the filmstrip followed by the complete 80-item test over the pictorial and narrative information contained in these frames.

A copy of the 80 test items which includes the pictorial and line drawings as they appeared in the filmstrip test is included in Appendix B. A listing of the question number(s) that followed each frame or sequence may be found in Appendix A (Tables 55 and 56).

"Hardware" Selected and Provision for Experimental and Control Groups

For each method of presentation, there was an experimental and a control group. Students were randomly assigned to these two groupings by classes. The experimental group received immediate knowledge of results (described below) during the treatment session, i.e., the filmstrip presentation phase. The control group at this time received no knowledge of results.

In looking for a relatively inexpensive device for conveying immediate knowledge of results, a punchboard (126) was selected. See Figure 1.

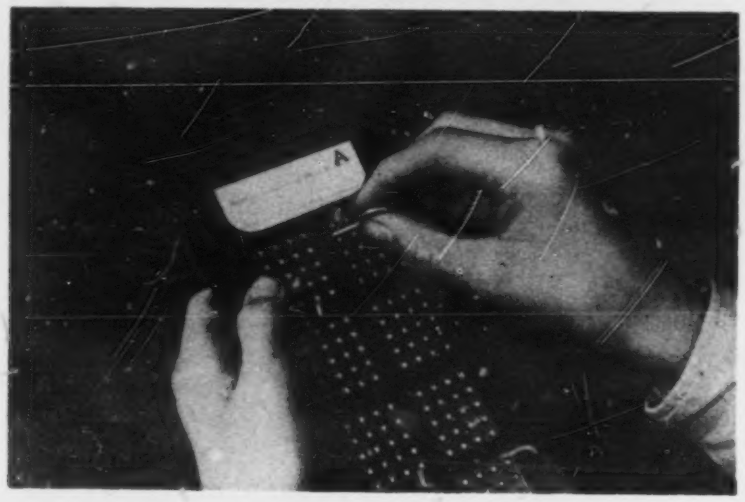


FIGURE 1

THE RAPID-RATER: A PUNCHBOARD DEVICE

This device allowed for the administration of a test containing as many as 80 multiple-choice questions. There were four columns of twenty numbers, each with holes labeled A, B, C, D. Two columns (1-40) were on one side of the punchboard (side A) and two columns (41-80) were on the other side (side B).

Each student made his response by inserting a stylus in the hole which he felt corresponded to the correct answer. If he was correct, the stylus penetrated the answer sheet and went through a hole in the scoring key, creating a large hole in the answer sheet. If he

2

was incorrect, the stylus penetrated only the answer sheet coming to rest against the scoring key, creating only a very small hole in the answer sheet. If he answered incorrectly, he went on to make a second, third, or even fourth attempt, until the correct answer had been selected. In this way, each student could tell immediately whether his answer was correct or incorrect.

All students involved in this study used this punchboard device. The answer keys, however, were removed before use by the control group in all sessions; thus no knowledge of results could be obtained from the recording of their responses. The answer keys were also removed for the experimental group in the delayed knowledge of results and retention testing sessions, since immediate knowledge of results was given individually to this group only in the treatment session.

Procedure for the Experimental and Control Groups in Four Sessions

1. Pre-treatment Testing Session

The main purpose of this session was to acquaint the students with the punchboard device used in the study. A series of two-by-two slides were made for this purpose. A print of each slide may be seen in Appendix C along with the directions that accompanied that slide.

After the students were acquainted with the punchboard device, two different 20-item multiple-choice tests were administered. The first was a practice test. The purpose of this test was to give the students further acquaintance with the punchboard and thus give them the assurance of knowing how to use the punchboard device successfully. The test was based on concepts in social studies, science, and arithmetic which all students should have learned prior to the fifth grade. These items were written with the help of an elementary teacher and were also given to a group of ten, fourth grade students to determine if the average fifth grade student could be expected to answer each item correctly without any difficulty. Students who missed four or more of these items were eliminated from the study on the basis that they did not demonstrate successfully that they knew how to use the punchboard.

The second test was a science achievement test based on a related aspect in astronomy given to measure initial achievement in this field. The scores on this measure were used as one of the two control factors in the analysis of covariance program applied to the data collected in the treatment session and in the delayed knowledge of results and retention testing sessions. Specifically these items were based on knowledge contained in the filmstrip, The Sun and Its Planets from the same Society for Visual Education series as Earth's Satellite: The Moon. The filmstrip was used in Part I of VanderMeer's filmstrip study (127). These 20 items were the best of 50 items written to cover the information presented by the filmstrip on the sun and were related to, but not identical with, the concepts to be presented by the filmstrip on the moon. Some of the items selected were pictorial drawings; the others were verbal. Minor revisions (based on an item analysis of the data which was collected by testing over the revised version of the filmstrip) were made to improve certain items. This procedure was the same as described earlier in this chapter. All items had been subjected to a critical review before they were used in Part I of VanderMeer's study. The reliability of this 20-item science achievement test was computed by means of the Kuder-Richardson Formula 21 (16:455). The coefficient obtained by this internal consistency method was estimated to be .38. It should be realized that the information in this test may have been unknown to the pupils and that this formula tends to underestimate reliability. Copies of the practice test and the science achievement test were in dittoed booklet form and may be found in Appendix D.

(a) Procedure for the Experimental Groups in the Pre-treatment Testing Session

The experimental groups were instructed in the use of the punchboard with the aid of the two-by-two slides which showed how to distinguish between correct and incorrect responses, i.e., whether or not the stylus goes in the hole far enough to make a larger hole in the answer sheet, thus indicating a correct response. In order to check their grasp of this instruction, the students were asked to write the letter of the correct answer for numbers one to twenty (using answer key number 2) on a special answer sheet which was numbered from one to twenty with a line provided beside each number for writing the letter of the response which they felt was correct.

After this, the practice test (21-40) was administered for which each individual received immediate knowledge as to the correctness of his response. Finally, the science achievement test was administered (41-60). This time the answer key for side B was left out so no knowledge of results would be given on these items; the experimental groups, therefore, had the opportunity to experience using the punchboard device as they would use it later in the delayed knowledge of results and retention testing sessions. Besides, reinforcement of this material by knowledge of results would have given the experimental group an undesirable advantage over the control group.

(b) Procedure for the Control Groups in the Pre-treatment Testing Session

The control groups were given general directions concerning the use of the punchboard device. The slides which pertained to distinguishing between the correct and the incorrect responses were omitted.

After a short practice session in which the students were permitted to punch at random in the first column (1-20) in order to gain the feeling of recording a response, the practice test (21-40) was administered. Since no knowledge of results was to be given to the control groups, the answer keys were left out of the punchboards. Following this test the science achievement test (41-60) was administered, also without knowledge of results.

The directions given to the groups by the investigator in the following three sessions may be found in Appendix E.

2. Treatment Session

The main purpose of the treatment session was to present the filmstrip by one of three methods: frame-by-frame, sequence, or whole. The arrangement of these methods was described above on pages 46 and 47.

In all three methods of presentation the narrative part of each frame of the filmstrip was read orally by the investigator. In addition, in frame two the number of satellites together with the name of each planet was read as it was pointed out on the screen by using the projector's built-in light pointer. At the same time, Mercury was mentioned as the smallest planet, Jupiter as the largest, and Saturn as the planet with rings around it. In frame six it was pointed out on the screen that sometimes the moon is as far away as 253,000 miles and at other times it is as close as 222,000 miles. After the investigator read orally the narrative part of each frame of the filmstrip, he paused, giving the students time to look over the pictorial material and to re-read the caption.

The questions which followed each frame, sequence, or the entire filmstrip were not read orally. Each question was projected on the screen long enough for at least 95% of the students to read and respond to it. The control groups were instructed to respond only once to each item. The answer keys had been left out of their punchboards since no knowledge of results was to be given to these groups. In the experimental groups answer key 1 was used in side A and answer key 8 was used in side B. If a student answered incorrectly on his first response, he was instructed to make a second, third, or even a fourth attempt, until he had selected the correct answer. In both groups, the word "next" was called out and all those who had not answered the item or had not finished answering the item were to raise their hands and then immediately select an answer (control group) or find the correct answer (experimental group).

In all grade divisions (five-six, seven-eight, and eleven) students were randomly assigned (by class groups) to be shown Earth's Satellite: The Moon by one of the three methods of presentation. These methods groups were in turn randomly divided into experimental and control groups. Furthermore, the disposition of the methods -- frame, sequence, and whole -- in each grade and the dispositions of the experimental and control groups for each method was randomly assigned. See Table 54 in Appendix A. The experimental treatments of the various groups are shown in Table 1.

(a) The Frame Method

The filmstrip was presented by the frame method to groups 3, 16, 10 and 4, 15, 9. After each frame, one or more questions were asked over the content of that frame. Groups 3, 16, 10 received immediate knowledge of results, i.e., as the student responded to each question, he knew whether his response was right or wrong. See above, p. 48. Groups 4, 15, 9 received no knowledge of results, i.e., the student did not know in the treatment session which of his responses were right or wrong.

(b) The Sequence Method

The filmstrip was presented by the sequence method to groups 1, 12, 7 and 2, 11, 8, i.e., one or more related frames were presented as a unit before the students were tested over the content of these related frames. Groups 1, 12, 7 received immediate knowledge of results, and groups 2, 11, 8 received no knowledge of results.

TABLE 1

COMPOSITION AND TREATMENT OF EXPERIMENTAL AND CONTROL GROUPS (1-18)

RESULTS:	Immediate Knowledge of Results			No Knowledge of Results*		
Testing Procedures	Immediate Testing	Sequence Testing	Delayed Testing	Immediate Testing	Sequence Testing	Delayed Testing
Grade 5-6	Group 3**	Group 1	Group 18	Group 4	Group 2	Group 17
Grade 7-8	Group 16	Group 12	Group 13	Group 15	Group 11	Group 14
Grade 11	Group 10	Group 7	Group 6	Group 9	Group 8	Group 5

* The control groups were tested by the same procedures as the experimental groups but without the answer keys in the punchboards.

** The groups are numbered according to the order in which they were subjected to the filmstrip presentation.

(c) The Whole Method

The entire filmstrip was presented to groups 18, 13, 6 and 17, 14, 5 without interruption. At the end of the presentation the students were tested over the content of the whole filmstrip. Groups 18, 13, 6 received immediate knowledge of results, and groups 17, 14, 5 received no knowledge of results.

3. Delayed Knowledge of Results Testing Session

The delayed knowledge of results testing session took place on the day immediately following the treatment session when the criterion measure was readministered for the second time. The purpose of this testing session was to give delayed knowledge of results to the control groups. This session also served to measure the effect of immediate knowledge of results, given in the treatment session, to the experimental groups only, on short-term retention (one day).

In order that the control groups receiving delayed knowledge of results would not have an added advantage over the experimental groups the same knowledge of results was given to all groups, i.e., as the correct answer to the question on the screen was announced by the investigator, the built-in light pointer was used to point to the correct letter and then to underscore the answer as the students read it silently. The punchboard devices were used again by all of the students to record their answers, but the answer keys had been removed so that the students would not know whether their first responses were right or wrong. The students were instructed to make only one response for each question, and they were told that they would not know whether their answers were right or wrong when they recorded them, but that when everyone in the class had answered the item, they would be told the correct answer. Each question was projected on the screen long enough for at least 95% of the group to answer it. Before the investigator announced the correct answer, the word "next" was called out and all those who had not answered the item were to raise their hand and then immediately select an answer. To see that the directions were followed, the students were watched by the investigator and proctors to see that they did not wait until the correct answer had been given by the investigator before recording their response.

4. Retention Testing Session

The purpose of the retention testing session was to measure long-term retention by readministering the criterion measure for the third time, twenty to twenty-five days following the filmstrip presentation in the treatment session. The procedure which was followed in the retention testing session was the same as was followed in the delayed knowledge of results testing session with the exception that knowledge of results was neither given to nor received by the students.

An analysis of Tables 2, 3, and 4 will reveal that in the fifth-sixth grade, the pre-treatment testing session, the treatment session, and the delayed knowledge of results testing session were all in consecutive order. In the seventh-eighth grade, the treatment session was held either two or five days after the pre-treatment

TABLE 2

A DESCRIPTION OF THE VARIOUS TEST SESSIONS FOR GRADE 5-6

Method	Session[#]	Date of Testing	Days between Sessions 2-4[#]	Time for Testing		Morning or Afternoon		Place of Testing
				IK[+]	NK[++]	IK	NK	
Frame	1	3/14/62		60	50	M-1**	M-2	Auditorium
	2	3/15/62)	24	73	68	M-1	M-2	
	3	3/16/62)		67	58	M-1	M-2	
	4	4/9/62)		50	40	M-1	M-2	
Sequence	1	3/12/62		65	50	M-1	LM-2	Auditorium
	2	3/13/62)	21	72	70	M-1	LM-2	
	3	3/14/62)		60	85	LM-1*	A-2	
	4	4/4/62)		40	56	M-1	LM-2	
Whole	1	4/24/62		60	60	M-2	M-1	Classroom
	2	4/25/62)	20	67	54	LM-2	M-1	
	3	4/26/62)		63	48	M-2	M-1	
	4	5/16/62)		50	36	M-2	M-1	

# 1. Pre-treatment testing session, 2. Treatment session, 3. Delayed knowledge of results testing session, 4. Retention testing session.

+ IK means Immediate knowledge of results (Experimental group)

++ NK means No knowledge of results (Control group)

* LM = Late morning

** 1 = the group randomly assigned to be first

TABLE 3

A DESCRIPTION OF THE VARIOUS TEST SESSIONS FOR GRADE 7-8

Method	Session#	Date of Testing	Days between Sessions 2-4#	Time for Testing IK+	Time for Testing NK++	Morning or Afternoon IK	Morning or Afternoon NK	Place of Testing
Frame	1	4/6/62				M-2	M-1**	Band Room
	2	4/12/62)	20	47	50	A-2	M-1	
	3	4/13/62)		43	40	M-2	M-1	
	4	5/3/62)		42	40	M-2	M-1	
Sequence	1	3/30/62				M-2	M-1	Band Room
	2	4/2/62)	24	53	44	A-2	A-1	
	3	4/3/62)		43	43	M-2	M-1	
	4	4/27/62)		35	37	M-2	M-1	
Whole	1	3/30/62				A-1	LA*2	Band Room
	2	4/5/62)	21	63	48	M-1	A-2	
	3	4/6/62)		48	37	A-1	LA-2	
	4	4/27/62)		40	37	A-1	LA-2	

1. Pre-treatment testing session, 2. Treatment session, 3. Delayed knowledge of results testing session, 4. Retention testing session.

+ IK means Immediate knowledge of results (Experimental group)

++ NK means No knowledge of results (Control group)

* LA = Late afternoon

** 1 = the group randomly assigned to be first

TABLE 4

A DESCRIPTION OF THE VARIOUS TEST SESSIONS FOR GRADE 11

Method	Session$^{\#}$	Date of Testing	Days between Sessions 2-4$^{\#}$	Time for Testing		Morning or Afternoon		Place of Testing
				IK^{+}	NK^{++}	IK	NK	
Frame	1	3/22/62				*LM-2	M-1**	Auditorium
	2	3/28/62)	25	40	41	LM-2	M-1	Auditorium
	3	3/29/62)		39	42	LM-2	M-1	A-V Room
	4	4/23/62)		30	27	LM-2	M-1	(IK-Choral Room (NK-Auditorium
Sequence	1	3/19/62 3/22/62				M-1 LA	A-2	Auditorium
	2	3/21/62 4/3/62)	20	55 46	47	M-1 LA	A-2	
	3	3/22/62 4/4/62)		40 42	44	M-1 LA	A-2	
	4	4/11/62 4/24/62)		25 28	25	M-1 LA	A-2	Choral Room/ Auditorium
Whole	1	3/19/62				LM-2	M-1	Auditorium
	2	3/20/62)	20	56	58	LM-2	M-1	
	3	3/21/62)		49	45	LM-2	M-1	
	4	4/10/62)		27	28	LM-2	M-1	

# 1. Pre-treatment testing session, 2. Treatment session, 3. Delayed knowledge of results testing session, 4. Retention testing session.

+ IK means Immediate knowledge of results (Experimental group)

++ NK means No knowledge of results (Control group)

* L = Late (morning or afternoon)

** 1 = the group randomly assigned to be first

testing session. Because of scheduling difficulty of one group in grade eleven, it was necessary to conduct the treatment session for that group eleven days after the pre-treatment testing session. In all grades, the delayed knowledge of results testing session was conducted the day following the treatment session. The retention testing session was held twenty to twenty-five days after the treatment session.

Because of the size of the groups and the projection of the test items, an attempt was made to hold all sessions in either the school auditorium or a special room set aside for audio-visual purposes. Due to the lack of other facilities in one fifth grade school, a regular classroom was used. In the junior high school the band room was used for the entire experiment, and in the senior high school the choral room was used on two occasions. With the exception of two eleventh grade groups, the experimental and control groups in each grade used the same facilities.

Selection of School Populations and Trial Run

On March 5, 1962, a conference was held with Mr. Frank Stevenson, Coordinator of The Division of Instructional Services for the Greenville County School System in Greenville, South Carolina. At this time a mimeographed prospectus of the project (Appendix F) was gone over and final approval was obtained for use of five Area III schools. In order to obtain sufficient population for the fifth-sixth grades, three schools were selected. In order to compensate for the socio-economic factor, one elementary school was selected from near the heart of the city, another several miles out, and the third still farther out of the city. In the same order, each school reflected a newer type of building design. All three elementary schools served as feeder schools for the modern junior high school located within their midst which in turn fed into the conventional high school located near the heart of the city.

On March 7, 8, and 9, 1962, conferences were held with the principal of each school. The purpose and procedure of the project were reviewed and a schedule was set up for the various sessions involved. At the junior high school, the project was also reviewed with the faculty at their weekly meeting. In all cases, the principals gave their full support and cooperation to the project. Testing began on March 12 and was concluded on May 16.

In the high school all of the students who were enrolled in eleventh grade English were included in the study. In the Junior High School, because there were not enough seventh or eighth graders, six of the eight, seventh grade classes were combined with six of the twelve, eighth grade classes. Paired fifth-sixth grade classes were used in the elementary schools for the same reason. The combination fifth-sixth grade class in each school was not included. In all cases, classes were randomly combined to form experimental and control groups. For the procedure followed in each session by the experimental and control groups, see above, pp. 49-54.

A trial run for each session was made with ten fourth grade children whose parents were members of the Bob Jones University faculty and staff. The problems encountered in each session were analyzed and steps were taken to correct these before presentation in the public schools. These sessions, for example, proved a need for a slide series to introduce and explain the use of the punchboards, provided a means of trying out the practice test and thereby improving the wording of certain items, and served to verify time allotments and clarify directions.

Thus, the population of this study consisted of 1190 students enrolled in the public schools of Greenville, South Carolina during the spring of 1962. Of these, 445 or 37.4% were eliminated for reasons shown in Tables 5, 6 and 7 which present data on the eliminated sample and give a breakdown of the reasons why various subjects were eliminated. From these tables it is apparent that fewer seventh-eighth and eleventh grade students had to be eliminated on the basis of the practice test because they did not understand how to use the punchboard. More seventh-eighth grade students in the sequence group for the retention testing session had a definite answer pattern. For example: such answer patterns had "C" punched all the way down a column, or "A, B, C, D" punched all the way across and down in a section, or a diagonal pattern was made by punching "A" for item one, "B" for item two, "C" for item three, etc. This seemed to indicate a lack of attention and seriousness of purpose on their part during the retention phase. The fifth-sixth and seventh-eighth grades had more students who could not be used because their permanent records did not contain a verbal IQ score based on the Lorge-Thorndike Intelligence Test. This may be due to a greater mobility of students

TABLE 5

AN ANALYSIS OF THE INACTIVE SAMPLE FOR GRADE LEVEL VARIABLES

	GRADES					
	5-6		7-8		11	
	N	%	N	%	N	%
I. Present but eliminated						
A. With proper IQ score						
1. Missed 4 or more items on Practice Test - Session 1[#]	30	7.1	18	4.3	2	.6
2. Assumed more than 8 items to be correct - Session 2[#]-IK[+]	3	.7	0	0	5	1.4
3. Had a definite answer pattern - Session 4[#]	1	.2	11	2.7	2	.6
4. Invalid - did not follow directions or answer sheets in punchboard wrong	2	.5	4	1.0	1	.2
Total IA	36	8.5	33	8.0	10	2.8
B. Without proper IQ score	54	12.8	36	8.7	7	2.0
Total IA & B	90	21.3	69	16.7	17	4.8
II. Absent thus eliminated	58	13.7	97	23.4	114	32.3
Total I & II	148	35.0	166	40.1	131	37.1
III. Number included	275	65.0	248	59.9	222	62.9
Total Possible (I, II, III)	423	100	414	100	353	100

[#] 1. Pre-treatment testing session, 2. Treatment session, 4. Retention testing session

[+] IK means Immediate knowledge of results (Experimental group)

TABLE 6

AN ANALYSIS OF THE INACTIVE SAMPLE FOR METHODS VARIABLES

	METHODS					
	Frame		Sequence		Whole	
	N	%	N	%	N	%
I. Present but eliminated						
A. With proper IQ score						
1. Missed 4 or more items on Practice Test - Session 1[#]	11	2.7	15	3.75	24	6.2
2. Assumed more than 8 items to be correct - Session 2[#] IK[+]	2	.5	3	.75	3	.8
3. Had a definite answer pattern - Session 4[#]	3	.7	8	2.00	3	.8
4. Invalid - did not follow directions or answer sheets in punchboard wrong	2	.5	3	.75	2	.5
Total IA	18	4.5	29	7.2	32	8.3
B. Without proper IQ score	21	5.2	29	7.2	47	12.2
Total IA & B	39	9.7	58	14.5	79	20.5
II. Absent thus eliminated	97	24.0	93	23.2	79	20.5
Total I & II	136	33.7	151	37.7	158	40.9
III. Number included	268	66.3	249	62.3	228	59.1
Total Possible (I, II, III)	404	100	400	100	386	100

[#] 1. Pre-treatment testing session, 2. Treatment session, 4. Retention testing session

[+] IK means Immediate knowledge of results (Experimental group)

TABLE 7

AN ANALYSIS OF THE INACTIVE SAMPLE FOR KNOWLEDGE OF RESULTS VARIABLES

	RESULTS					
	IK^{+}		NK^{++}			
	N	%	N	%	Grand Total	
I. Present but eliminated						
A. With proper IQ score						
1. Missed 4 or more on Practice Test - Session 1$^{\#}$	29	4.8	21	3.6	50	4.2
2. Assumed more than 8 items to be correct - Session 2$^{\#}$IK^{+}	8	1.3	0	.0	8	.7
3. Had a definite answer pattern - Session 4$^{\#}$	6	1.0	8	1.3	14	1.2
4. Invalid - did not follow directions or answer sheets in punchboard wrong	5	.8	2	.3	7	.6
Total IA	48	8.0	31	5.2	79	6.6
B. Without proper IQ score	47	7.8	50	8.5	97	8.2
Total IA & B	95	15.8	81	13.7	176	14.8
II. Absent thus eliminated	149	24.9	120	20.3	269	22.6
Total I & II	244	40.7	201	34.0	445	37.4
III. Number included	355	59.3	390	66.0	745	62.6
Total Possible (I, II, III)	599	100	591	100	1,190	100

# 1. Pre-treatment testing session, 2. Treatment session, 4. Retention testing session

+ IK means Immediate knowledge of results (Experimental group)

++ NK means No knowledge of results (Control group) in the lower grades. Also, of the three methods of presentation, the whole method had more students who did not have a proper IQ score. Of those present, 9.7% had to be eliminated from the frame method, 14.5% from the sequence method, and 20.5% from the whole method. Of the total number eliminated, there were more absent in the immediate knowledge of results group. Although fewer of those present in the eleventh grade (Table 8) had to be eliminated for one of the five stated reasons, there were more eleventh than seventh-eighth or fifth-sixth grade students who had to be eliminated because of absenteeism in one or more of the sessions. The seventh-eighth grade also had more absenteeism than the fifth-sixth grade. This increase in absenteeism through the grades may be accounted for by the repeal of South Carolina's compulsory attendance law in 1955 as a "safeguard" against enforced integration in public schools and the lack of enforcement, according to the State Attorney General, of a 1957 legislative act which ". . . makes it unlawful for any person to knowingly and wilfully encourage or influence a minor to become and be habitually truant" (130). Although the vast majority of those absent missed only one session, we can observe from Table 9 (a summary of the session(s) missed by those in the inactive sample) that an increasing number were absent in each of the four succeeding sessions. This might suggest an avoidance on the part of the students, particularly if they had found out when the sessions were scheduled. The last testing session for grade eleven is a good example of this increased absenteeism, for it doubled that of any previous session.

Of the 1190 students who participated in the study, 745 or 62.6% met all the criteria: (1) a proper IQ score, (2) attendance at all

TABLE 8

NUMBER OF TIMES ABSENT BY THOSE IN THE INACTIVE SAMPLE

Number of Times Absent	GRADES			METHODS			RESULTS		Grand Total
	5-6	7-8	11	Frame	Sequence	Whole	IK+	NK++	
One	43	68	76	67	62	58	100	87	187
Two	11	11	23	18	16	11	27	18	45
Three	4	18	15	12	15	10	22	15	37
Total	58	97	114	97	93	79	149	120	269

+ IK means Immediate knowledge of results (Experimental group)

++ NK means No knowledge of results (Control group)

TABLE 9

SESSIONS(S) MISSED BY THOSE ABSENT IN THE INACTIVE SAMPLE

Session(s) Missed	GRADES			METHODS			RESULTS		Grand Total
	5-6	7-8	11	Frame	Sequence	Whole	IK[+]	NK[++]	
1. Pre-treatment	21	18	29	24	23	21	44	24	68
2. Treatment	20	28	34	22	39	21	47	35	82
3. Delayed Knowledge of Results	15	42	34	34	28	29	52	39	91
4. Retention	21	56	70	59	49	39	77	70	147
Total	77	144	167	139	139	110	220	168	388

[+] IK means Immediate knowledge of results (Experimental group)

[++] NK means No knowledge of results (Control group) four sessions, and (3) satisfactory use of the punchboard device. The findings of this present study are based on these students.

Treatment and Analysis of Data

The scores of the various measures were summarized on 5x8 color-coded cards for each student. These scores and other identifying data were transferred to IBM cards which were then sorted and combined into the following seven groups for analysis: (1) Total Methods, (2) Total Results, (3) Total Grades, (4) Methods x Results, (5) Grades x Results, (6) Methods x Grades, (7) Methods x Results x Grades. The data for each of these groupings were analyzed three times, i.e., for the treatment session and the delayed knowledge of results and retention testing sessions. An analysis of covariance program with two covariants (115) was used to adjust and analyze the mean differences for significance in each of the seven combinations. If the null hypothesis was rejected, the adjusted means were then paired for further gross analysis by the Least Significant Difference Method (36:114). Finally, an analysis of variance (39:199-201) was used to determine whether differences among adjusted means owe their divergencies to methods variables, results variables, grade level variables or to an interaction of any of the possible combinations of these variables.

The two covariants used in the analysis of covariance program were intelligence quotients and scores on a 20-item science achievement test. The intelligence quotients used were taken from the students' permanent records. The fifth grade students had all been given the Lorge-Thorndike Intelligence Test in the fourth grade and the results were reported in verbal and non-verbal scores. The sixth grade students, not only had these scores, but also those from a more recent testing earlier that same year. The seventh and eighth grade students also had been given the Lorge-Thorndike Intelligence Test in the sixth grade and had both verbal and non-verbal scores recorded. All eleventh grade students had only a general intelligence quotient based on the Otis Beta test given in their tenth grade.

In the fifth-sixth and seventh-eighth grade groupings, various correlations were computed to determine which IQ scores were most related to the scores on the criterion measure and on the science achievement test. These correlations may be found in Tables 10 and 11. It will be noted that the verbal IQ scores were all more highly related to the scores for the other test measures than the non-verbal IQ scores. It will also be noted that in the fifth-sixth grade, the sixth grade IQ scores were more highly related to the scores on the criterion measure and the science achievement test than the fourth grade IQ scores. In light of this evidence and because of the nature of the presentation, the verbal intelligence scores were used. Also, reasoning that the more recent scores would be the most valid, the sixth grade verbal scores were used for the sixth grade students.

TABLE 10

SYMMETRIC CORRELATION MATRIX OF TEST SCORES FOR GRADE 5-6

(N = 275)

Grade 5-6	Science Achiev. Test	4th VIQ*	4th NVIQ*	6th VIQ*	6th NVIQ*
**Treatment Session	.38	.50	.45	.54	.50
**Delayed Knowledge of Results Session	.31	.39	.35	.42	.37
**Retention Testing Session	.43	.53	.45	.57	.50
Science Achievement Test		.24	.14	.28	.21
4th VIQ			.58	.84	.55
4th NVIQ				.53	.83
6th VIQ					.57

* V = Verbal IQ; NV = Non-verbal IQ; 4 = fourth grade IQ scores used for both fifth and sixth grade students; 6 = sixth grade IQ scores used for sixth grade students and fourth grade IQ scores used for fifth grade students.

** The 80-item criterion measure was used.

TABLE 11

SYMMETRIC CORRELATION MATRIX OF TEST SCORES FOR GRADE 7-8

(N = 248)

Grade 7-8	Science Achiev. Test	6th VIQ*	6th NVIQ*
**Treatment Session	.45	.46	.39
**Delayed Knowledge of Results Session	.43	.42	.34
**Retention Testing Session	.43	.44	.40
Science Achievement Test		.35	.32
6th VIQ			.57

* V = verbal IQ; NV = non-verbal IQ; 6 = sixth grade IQ scores used for both seventh and eighth grade students.

** The 80-item criterion measure was used.

Chapter IV

ANALYSIS OF DATA

The data collected in this study was analyzed according to seven possible combinations, using the scores on the criterion measure from the treatment session and from the delayed knowledge of results and retention testing sessions. A description and analysis of the resulting statistics is presented under the following categories.

1. Total methods: Frame, Sequence, and Whole
2. Total Results: Immediate Knowledge of Results and Delayed Knowledge of Results
3. Total Grades: Fifth-sixth, Seventh-eighth, and Eleventh
4. Methods x Results
5. Grades x Results
6. Methods x Grades
7. Methods x Results x Grades

In order to reduce the experimental error and thereby gain precision in this experiment, the analysis of covariance method was used. Two covariants, intelligence quotients and scores on a science achievement test which was given prior to instruction, were employed. When a statistically significant F occurred, indicating that non-chance variations among the adjusted means existed, then further analysis was made employing the Least Significance Difference method to find out where and to what extent the significance occurred.

Descriptive data for each group in the seven combinations may be found in Tables 58 and 64 located in Appendix G. These tables include the number of boys and girls and the means, standard deviations, and ranges for the following factors: intelligence quotients, scores on the science achievement test, and scores for the criterion measure used in the treatment session and in the delayed knowledge of results and retention testing sessions.

Total Methods

When the three methods of filmstrip presentation (frame-by-frame, sequence, and whole) were compared, statistically significant differences in adjusted mean scores were found only in the treatment session (Table 12). In this session, those groups to whom the filmstrip was presented a frame at a time achieved the highest adjusted mean score. The second highest adjusted mean score was obtained by the students to whom the filmstrip was presented a sequence at a time, and the lowest score was obtained by the students to whom the filmstrip was presented by the whole method. Each of these differences in adjusted mean scores (Table 15) was significant at the .01 level of confidence from each other as to the effectiveness of conveying the same content.

No significant differences (Tables 13 and 14) were observed among the adjusted mean scores on the criterion measure for the delayed knowledge of results and retention testing sessions; however, in the delayed knowledge of results testing session the adjusted mean

TABLE 12

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR METHODS VARIABLES -- TREATMENT SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Methods	2	10141.28	5070.64	49.56**
Within	740	75717.08	102.32	
Total	742	85858.36		

Treatment: Methods	N	Adjusted $\overline{X}$
1. Frame	268	61.91
2. Sequence	249	56.95
3. Whole	228	52.78
	745	

** Significant at .01 Level of Confidence

TABLE 13

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR METHODS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Methods	2	491.78	245.89	2.28
Within	740	79883.07	107.95	
Total	742	80374.85		

Treatment: Methods	N	Adjusted $\bar{X}$
1. Frame	268	60.81
2. Sequence	249	61.96
3. Whole	228	59.93
	745	

TABLE 14

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR METHODS VARIABLES -- RETENTION TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Methods	2	216.12	108.06	1.03
Within	740	77866.99	105.23	
Total	742	78083.12		

Treatment: Methods	N	Adjusted $\overline{X}$
1. Frame	268	52.23
2. Sequence	249	53.44
3. Whole	228	52.40
	745	

TABLE 15

ADJUSTED MEAN SCORES FOR METHODS VARIABLES -- TREATMENT SESSION

(Data shown in parentheses are Least Significant Differences.)

Methods	$\bar{X}$	$\bar{X}$-3#	$\bar{X}$-2
1. Frame	61.91	9.13** (2.36)	4.96** (2.30)
2. Sequence	56.95	4.17** (2.41)	
3. Whole	52.78		

# The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

** Significant at .01 Level of Confidence.

scores for the sequence and whole methods groups were a little higher than the scores for the same groups in the treatment session. The frame method group, evidently saturated from the treatment session, did not profit from the knowledge of results given in the delayed knowledge of results testing session as did the sequence and whole methods groups. Thus it appears that the initial differences which existed in the treatment session were virtually wiped out by the delayed knowledge of results testing session. After three weeks, in the _retention testing session_, the adjusted mean scores on the criterion measure for the frame, sequence, and whole methods were within one point of the lowest adjusted mean score (whole method) in the treatment session.

Three conclusions may be made from the data presented in this section: (1) in the initial presentation of new material by means of a filmstrip, more learning takes place when the small-step frame-by-frame presentation is used; (2) as for recall of the information after a short period of assimilation (1 day), there is no significant difference in adjusted mean scores for the amount recalled even though different methods of presentation were initially used; and (3) as for retention of the information after approximately three weeks, the amount _retained_ by the students in the frame, sequence, and whole methods groups was no less than that originally _learned_ in the treatment session by the students in the whole method group.

Total Results

No statistically significant difference between the adjusted means of the experimental (immediate knowledge of results) and the control (no knowledge of results) groups of this study was revealed in the treatment session and in the retention testing session (Tables 16 and 18). However, in measuring recall on the day after the filmstrip presentation (delayed knowledge of results testing session), it was observed (Table 17) that the experimental group, having received immediate knowledge of results during the presentation phase, obtained a significantly higher (.01) adjusted mean score on the criterion measure than the control group which received no knowledge of results.

The adjusted means for both the experimental and the control groups were higher in the delayed knowledge of results testing session than in the treatment session. Even though the delayed knowledge of results testing session was on the day following the presentation of the filmstrip, this difference in adjusted mean scores favoring the delayed knowledge of results testing session may be due to the fact that both groups received delayed knowledge of results at this time. Therefore, the significant difference in scores which occurred in the delayed knowledge of results testing session may be due to the additional reinforcement which the experimental group received. Although immediate knowledge of results appears to have some significance in immediate (1 day) retention of new material, it does not have, according to the findings of this study, any lasting effect on long term (three weeks) retention of this material (Table 18).

TABLE 16

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Results	1	33.50	33.50	.29
Within	741	85824.86	115.82	
Total	742	85858.36		

Treatment: Results	N	Adjusted $\bar{X}$
1. I Know+	355	57.24
2. No Know++	390	57.66
	745	

[+] I Know means Immediate knowledge of results (Experimental group).

[++] No Know means No knowledge of results (Control group).

TABLE 17

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Results	1	1005.57	1005.57	9.39**
Within	741	79369.28	107.11	
Total	742	80374.85		

Treatment: Results	N	Adjusted $\bar{X}$
1. I Know+	355	62.15
2. No Know++	390	59.81
	745	

** Significant at .01 Level of Confidence.

+ I Know means Immediate knowledge of results (Experimental group).

++ No Know means No knowledge of results (Control group).

TABLE 18

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR KNOWLEDGE OF RESULTS VARIABLES -- RETENTION TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Results	1	41.49	41.49	.39
Within	741	78041.63	105.32	
Total	742	78083.12		

Treatment: Results	N	Adjusted $\overline{X}$
1. I Know[+]	355	52.93
2. No Know[++]	390	52.46
	745	

[+] I Know means Immediate knowledge of results (Experimental group).

[++] No Know means No knowledge of results (Control group).

Total Grades

An analysis of the data entered in Tables 19, 20, and 21 reveals significant differences in the amount learned and retained at different grade levels. The seventh-eighth and eleventh grade students learned and retained significantly more than the fifth-grade students. Those in grade eleven also obtained significantly higher scores than those in grade seven-eight. This significant relationship among the adjusted means for different grade levels held true in all three sessions (Tables 22, 23, and 24), i.e., in the presentation session and in the short and long term retention testing sessions. The junior high students achieved adjusted mean scores which were an average of 3.53 points more than the scores of the elementary students; whereas, the high school students scored an average of 7.91 points more than the junior high students.

In measuring immediate retention (delayed knowledge of results testing session) those students in grades five-six and seven-eight showed an average gain in their adjusted mean scores of 4.15 points. Those in grade eleven showed a gain of 1.84 points. Here again appears the phenominal rise in adjusted mean scores from the treatment session to the delayed knowledge of results testing session. The students in grade eleven, who showed an increase of only 1.84 points, were least affected by the second exposure of the criterion measure which was accompanied with delayed knowledge of results.

In the retention testing session, some three weeks later, even though the eleventh grade students still made significantly higher scores than the seventh-eighth grade students and the seventh-eighth

TABLE 19

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE
FOR GRADE LEVEL VARIABLES -- TREATMENT SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades	2	18895.76	9447.88	104.41**
Within	740	66962.59	90.49	
Total	742	85858.36		

Treatment: Grades	N	Adjusted $\bar{X}$
1. 5-6	275	52.40
2. 7-8	248	56.19
3. 11	222	65.15
	745	

** Significant at .01 Level of Confidence.

TABLE 20

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades	2	12390.26	6195.13	67.43**
Within	740	67984.59	91.87	
Total	742	80374.85		

Treatment: Grades	N	Adjusted $\bar{X}$
1. 5-6	275	56.56
2. 7-8	248	60.33
3. 11	222	66.99
	745	

**Significant at .01 Level of Confidence.

TABLE 21

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES -- RETENTION TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades	2	14545.09	7272.55	84.70**
Within	740	63538.02	85.86	
Total	742	78083.12		

Treatment: Grades	N	Adjusted $\overline{X}$
1. 5-6	275	48.36
2. 7-8	248	51.39
3. 11	222	59.49
	745	

** Significant at .01 Level of Confidence.

TABLE 22

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES -- TREATMENT SESSION

(Data shown in parentheses are Least Significant Differences.)

Grades	$\bar{X}$	$\bar{X}$-1[#]	$\bar{X}$-2
3. Grade 11	65.15	12.75** (2.23)	8.96** (2.28)
2. Grade 7-8	56.19	3.79** (2.15)	
1. Grade 5-6	52.40		

[#] The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

** Significant at .01 Level of Confidence.

TABLE 23

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Data shown in parentheses are Least Significant Differences)

Grades	$\bar{X}$	$\bar{X}$-1[#]	$\bar{X}$-2
3. Grade 11	66.99	10.43** (2.23)	6.66** (2.31)
2. Grade 7-8	60.33	3.77** (2.18)	
1. Grade 5-6	56.56		

[#] The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

** Significant at .01 Level of Confidence.

TABLE 24

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES -- RETENTION TESTING SESSION

(Data shown in parentheses are Least Significant Differences.)

Grades	$\overline{X}$	$\overline{X}$-1[#]	$\overline{X}$-2
3. Grade 11	59.49	11.13** (2.18)	8.10** (2.23)
2. Grade 7-8	51.39	3.03** (2.10)	
1. Grade 5-6	48.36		

[#] The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

** Significant at .01 Level of Confidence.

grade students made significantly higher scores than the fifth-sixth grade students, there is a greater difference in adjusted mean scores for grade eleven (between the treatment and the retention testing sessions) than for grades seven-eight and five-six. The least difference in adjusted mean scores between the treatment session and the retention testing session was observed in grade five-six.

Methods x Results

This section will describe the interrelationships which exist between the data grouped for comparison by methods and results. The analysis of covariance for the treatment session and the delayed knowledge of results testing session revealed that statistically significant differences (Tables 25 and 26) among the adjusted mean scores existed. No statistically significant differences in adjusted mean scores, however, were evident in the retention testing session (Table 27).

When the adjusted mean scores for the treatment session (Table 28) were further analyzed, the three methods of presentation appeared in rank order again, i.e., frame, sequence, and whole. The knowledge of results variables did not appear in any statistically significant order. The adjusted means for the control and experimental groups within each method were not significantly different from each other. The adjusted mean scores for both of the frame method groups were significantly higher, at the .01 level of confidence, than the adjusted mean scores for the sequence and whole methods groups; and the scores

TABLE 25

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Methods X Results	5	10359.56	2071.91	20.23**
Within	737	75498.80	102.44	
Total	742	85858.36		

Treatment: Methods X Results	N	Adjusted $\bar{X}$
1. Frame IK[+]	135	61.08
2. Sequence IK	115	57.15
3. Whole IK	105	52.44
4. Frame NK[++]	133	62.75
5. Sequence NK	134	56.78
6. Whole NK	123	53.08
	745	

** Significant at .01 Level of Confidence.

[+] IK means Immediate knowledge of results (Experimental group).

[++] NK means No knowledge of results (Control group).

TABLE 26

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Methods X Results	5	1700.44	340.09	3.19**
Within	737	78674.41	106.75	
Total	742	80374.85		

Treatment: Methods X Results	N	Adjusted $\bar{X}$
1. Frame IK[+]	135	61.92
2. Sequence IK	115	63.93
3. Whole IK	105	60.51
4. Frame NK[++]	133	59.69
5. Sequence NK	134	60.28
6. Whole NK	123	59.40
	745	

** Significant at .01 Level of Confidence.

[+] IK means Immediate knowledge of results (Experimental group).

[++] NK means No knowledge of results (Control group).

TABLE 27

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- RETENTION TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Methods X Results	5	272.27	54.45	.52
Within	737	77810.85	105.58	
Total	742	78083.12		

Treatment: Methods X Results	N	Adjusted $\bar{X}$
1. Frame IK[+]	135	52.55
2. Sequence IK	115	53.80
3. Whole IK	105	52.49
4. Frame NK[++]	133	51.90
5. Sequence NK	134	53.13
6. Whole NK	123	52.32
	745	

[+] IK means Immediate knowledge of results (Experimental group).

[++] NK means No knowledge of results (Control group).

TABLE 28

ADJUSTED MEAN SCORES FOR METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION

(Data shown in parentheses are Least Significant Differences.)

Methods X Results	$\bar{X}$	$\bar{X}$-3#	$\bar{X}$-6	$\bar{X}$-5	$\bar{X}$-2	$\bar{X}$-1
4. Frame NK++	62.75	10.31** (3.43)	9.67** (3.29)	5.97** (3.21)	5.60** (3.35)	1.67 (2.44)
1. Frame IK+	61.08	8.64** (3.38)	8.00** (3.26)	4.30** (3.19)	3.93** (3.33)	
2. Sequence IK	57.15	4.71** (3.56)	4.07** (3.41)	.37 (2.54)		
5. Sequence NK	56.78	4.34** (3.43)	3.70** (3.26)			
6. Whole NK	53.08	.64 (2.64)				
3. Whole IK	52.44					

The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

for the sequence method groups were significantly higher than those for the whole method groups.

For the delayed knowledge of results testing session (Table 29), the methods x results groups appeared in a different order. The methods variables of the experimental groups ranked over those of the control groups. The rank order of the methods variables for both the experimental and control groups were as follows: from sequence, to frame, to whole (experimental groups); to sequence, to frame, to whole (control groups). All of the groups which received immediate knowledge of results ranked ahead of those which received only delayed knowledge of results. The one group with an adjusted mean score significantly different from the score for any other group was the immediate knowledge of results group for the sequence method. The higher adjusted mean score for this group differed significantly at the .01 level of confidence from the adjusted mean scores for all of the no knowledge of results groups, and at the .05 level of confidence from the adjusted mean score of the immediate knowledge of results group for the whole method. The score for this group (the experimental group for the sequence method) did not differ significantly from the score of the experimental group for the frame method. All other group comparisons between the adjusted mean scores showed no significant differences.

The adjusted mean scores for the delayed knowledge of results testing session was higher than those obtained in the treatment session; the greatest gains were observed (1) in the experimental group which was subjected to the sequence method and (2) in both groups

TABLE 29

ADJUSTED MEAN SCORES FOR METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Data shown in parentheses are Least Significant Differences.)

Methods X Results	$\bar{X}$	$\bar{X}$-6[#]	$\bar{X}$-4	$\bar{X}$-5	$\bar{X}$-3	$\bar{X}$-1
2. Sequence IK[+]	63.93	4.53** (3.48)	4.24** (3.43)	3.65** (3.41)	3.42* (2.74)	2.01 (2.58)
1. Frame IK	61.92	2.52 (2.54)	2.23 (2.48)	1.64 (2.48)	1.41 (2.64)	
3. Whole IK	60.51	1.11 (2.70)	.82 (2.66)	.23 (2.66)		
5. Sequence NK[++]	60.28	.88 (2.54)	.59 (2.48)			
4. Frame NK	59.69	.29 (2.54)				
6. Whole NK	59.40					

[#] The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

[+] IK means Immediate knowledge of results (Experimental group).

[++] NK means No knowledge of results (Control group).

(experimental and control) which were subjected to the whole method.

The difference between the adjusted means obtained in the treatment session was 10.31; whereas, the difference between the adjusted means obtained in the delayed knowledge of results testing session was 4.53. Learning differences appear to be less and the groups more homogeneous as a result of the delayed knowledge of results testing session. This homogeneity among the groups is also found in the retention testing session where the difference between the adjusted mean scores is 1.90, even less than in the delayed knowledge of results testing session.

Grades x Results

This section will describe the interrelationships which exist between the data grouped for comparison by grades and results. The analysis of covariance for the treatment session and for the delayed knowledge of results and retention testing sessions (Tables 30, 31, and 32), revealed that statistically significant interactions were present among the adjusted mean scores for the various groups.

In all three sessions, the adjusted mean scores for the experimental and control groups in grade eleven were significantly higher, at the .01 level of confidence, than those for the experimental and control groups in grades seven-eight and five-six.

In the treatment session (Table 33), the adjusted mean scores of the experimental and control groups for grade seven-eight were significantly higher, at either the .01 or the .05 level of confidence,

TABLE 30

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Results	5	20148.49	4029.70	45.20**
Within	737	65709.87	89.16	
Total	742	85858.36		

Treatment: Grades X Results	N	Adjusted $\bar{X}$
1. 5-6 IK+	127	51.24
2. 7-8 IK	120	57.83
3. 11 IK	108	63.92
4. 5-6 NK++	148	53.31
5. 7-8 NK	128	54.64
6. 11 NK	114	66.42
	745	

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 31

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Results	5	13604.35	2720.87	30.03**
Within	737	66770.50	90.60	
Total	742	80374.85		

Treatment: Grades X Results	N	Adjusted $\bar{X}$
1. 5-6 IK⁺	127	57.81
2. 7-8 IK	120	62.20
3. 11 IK	108	67.41
4. 5-6 NK⁺⁺	148	55.43
5. 7-8 NK	128	58.56
6. 11 NK	114	66.68
	745	

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 32

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- RETENTION TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Results	5	15359.11	3071.82	36.09**
Within	737	62724.00	85.11	
Total	742	78083.12		

Treatment: Grades X Results	N	Adjusted $\overline{X}$
1. 5-6 IK+	127	48.97
2. 7-8 IK	120	52.61
3. 11 IK	108	58.20
4. 5-6 NK++	148	47.77
5. 7-8 NK	128	50.22
6. 11 NK	114	60.81
	745	

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 33

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION

(Data shown in parentheses are Least Significant Differences.)

Grades X Results	$\overline{X}$	$\overline{X}$-1[#]	$\overline{X}$-4	$\overline{X}$-5	$\overline{X}$-2	$\overline{X}$-3
6. 11 NK[++]	66.42	15.18** (3.17)	13.11** (3.06)	11.78** (3.17)	8.59** (3.20)	2.50* (2.50)
3. 11 IK[+]	63.92	12.68** (3.22)	10.61** (3.08)	9.28** (3.22)	6.09** (3.25)	
2. 7-8 IK	57.83	6.59** (3.12)	4.52** (3.00)	3.19** (3.12)		
5. 7-8 NK	54.64	3.40** (3.06)	1.33* (1.11)			
4. 5-6 NK	53.31	2.07* (1.11)				
1. 5-6 IK	51.24					

[#] The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

than the adjusted mean scores for the experimental and control groups in grade five-six.

In the delayed knowledge of results testing session (Table 34) and in the retention testing session (Table 35), the immediate knowledge of results group of grade seven-eight made a mean score which was significantly superior (a) to the one made by the no knowledge of results group in grade seven-eight and (b) to the ones made by both the knowledge of results and no knowledge of results groups in the fifth-sixth grade. Furthermore, the no knowledge of results group of the seventh-eighth grade made a score that was significantly higher than the one made by the no knowledge of results group of the fifth-sixth grade. However, the same seventh-eighth grade group did not score significantly higher (in the same sessions) than the immediate knowledge of results group of the fifth-sixth grade.

In all three sessions, the eleventh grade groups ranked first, the seventh-eighth grade groups ranked second, and the fifth-sixth grade groups ranked third. In the delayed knowledge of results testing session the adjusted mean scores for the immediate knowledge of results groups within each grade level ranked over those for the no knowledge of results groups. In grade eleven, however, this superior ranking of the experimental group was non-significant.

In the treatment session and in the retention testing session the adjusted mean for the eleventh grade group which received no knowledge of results was significantly superior, at the .05 level of confidence, to that for the eleventh grade group which received immediate knowledge of results. In the treatment session, the adjusted

TABLE 34

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Data shown in parentheses are Least Significant Differences.)

Grades X Results	$\bar{X}$	$\bar{X}$-4#	$\bar{X}$-1	$\bar{X}$-5	$\bar{X}$-2	$\bar{X}$-6
3. 11 IK+	67.41	11.98** (3.11)	9.60** (3.25)	8.85** (3.22)	5.21** (3.28)	.73 (2.52)
6. 11 NK	66.68	11.25** (3.08)	8.87** (3.20)	8.12** (3.20)	4.48** (3.22)	
2. 7-8 IK	62.20	6.77** (3.03)	4.39** (3.15)	3.64** (3.15)		
5. 7-8 NK++	58.56	3.13** (2.98)	.75 (2.34)			
1. 5-6 IK	57.81	2.38* (2.27)				
4. 5-6 NK	55.43					

The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* The significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 35

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- RETENTION TESTING SESSION

(Data shown in parentheses are Least Significant Differences)

Grades X Results	$\bar{\bar{X}}$	$\bar{\bar{X}}$-4#	$\bar{\bar{X}}$-1	$\bar{\bar{X}}$-5	$\bar{\bar{X}}$-2	$\bar{\bar{X}}$-3
6. 11 NK++	60.81	13.04** (2.98)	11.84** (3.09)	10.59** (3.09)	8.20** (3.15)	2.61* (2.44)
3. 11 IK+	58.20	10.43** (3.03)	9.23** (3.15)	7.98** (3.15)	5.59** (3.17)	
2. 7-8 IK	52.61	4.84** (2.93)	3.64** (3.04)	2.39* (2.30)		
5. 7-8 NK	50.22	2.45* (2.19)	1.25 (2.29)			
1. 5-6 IK	48.97	1.20 (2.21)				
4. 5-6 NK	47.77					

# The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence. ** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

mean for the fifth-sixth grade group which received _no_ knowledge of results also ranked significantly (.05) higher than the adjusted mean for the fifth-sixth grade group which received _immediate_ knowledge of results.

Although the immediate knowledge of results group for the fifth-sixth grade in the _delayed knowledge of results_ and _retention testing sessions_ ranked over the no knowledge of results group, the adjusted mean for the immediate knowledge of results group was only significantly higher (.05) than the adjusted mean for the no knowledge of results group in the delayed knowledge of results testing session. The fact that the adjusted mean score for the immediate knowledge of results group ranked over the no knowledge of results group in the retention testing session may have been because of the additional knowledge of results given to this group in the delayed knowledge of results testing session.

The difference between the lowest and highest adjusted mean scores was the greatest in the treatment session (15.18) and was the least in the delayed knowledge of results testing session (11.98). It was the immediate knowledge of results groups which achieved the greatest gain in adjusted mean scores from the treatment session to the delayed knowledge of results testing session. As far as grades are concerned, the seventh-eighth and fifth-sixth grades achieved the greater gain in adjusted mean scores. A combination of the data for grades and results revealed that the fifth-sixth grade group which received immediate knowledge of results achieved the greatest gain. This same group forgot less (according to the adjusted mean scores) from the treatment session to the retention testing session.

Grades x Methods

This section will describe the interrelationships which exist between the data grouped for comparison by grades and methods. Tables 36, 37, and 38 summarize the results of the analysis of covariance applied to the data for the treatment session and for the delayed knowledge of results and retention testing sessions. The F ratio obtained for each session was found to be significant at the .01 level of confidence.

In the *treatment session* (Table 39) the grade level and presentation method may be ranked (according to the respective adjusted mean scores on the criterion measure) in the following descending order.

Grade 11 - frame method
Grade 11 - sequence method
Grade 11 - whole method
Grade 7-8 - frame method
Grade 5-6 - frame method
Grade 7-8 - sequence method
Grade 5-6 - sequence method
Grade 7-8 - whole method
Grade 5-6 - whole method

A scrutiny of the above ranking reveals that method variables had a greater influence on the amount learned in grades seven-eight and five-six than did grade level variables. The adjusted mean scores for the *seventh-eighth* grade methods groups (frame, sequence, and whole) were significantly higher than the scores for the same *fifth-sixth* grade methods groups. The adjusted mean score for the *eleventh grade*

TABLE 36

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES -- TREATMENT SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Methods	8	31111.33	3888.92	52.14**
Within	734	54747.03	74.59	
Total	742	85858.36		

Treatment: Grades X Methods	N	Adjusted $\overline{X}$
1. 5-6 Frame	111	57.72
2. 5-6 Sequence	81	52.10
3. 5-6 Whole	83	45.93
4. 7-8 Frame	87	61.58
5. 7-8 Sequence	93	55.07
6. 7-8 Whole	68	50.94
7. 11 Frame	70	68.38
8. 11 Sequence	75	64.46
9. 11 Whole	77	62.39
	745	

** Significant at .01 Level of Confidence.

TABLE 37

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Methods	8	13635.82	1704.48	18.75**
Within	734	66739.03	90.93	
Total	742	80374.85		

Treatment: Grades X Methods	N	Adjusted $\bar{X}$
1. 5-6 Frame	111	57.59
2. 5-6 Sequence	81	58.43
3. 5-6 Whole	83	53.49
4. 7-8 Frame	87	59.73
5. 7-8 Sequence	93	61.01
6. 7-8 Whole	68	60.20
7. 11 Frame	70	66.79
8. 11 Sequence	75	66.88
9. 11 Whole	77	67.10
	745	

** Significant at .01 Level of Confidence.

TABLE 38

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR
GRADE LEVEL VARIABLES X METHODS VARIABLES --
RETENTION TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Methods	8	15709.32	1963.66	23.11**
Within	734	62373.80	84.98	
Total	742	78083.12		

Treatment: Grades X Methods	N	Adjusted $\overline{X}$
1. 5-6 Frame	111	48.98
2. 5-6 Sequence	81	49.54
3. 5-6 Whole	83	46.42
4. 7-8 Frame	87	52.07
5. 7-8 Sequence	93	50.69
6. 7-8 Whole	68	51.48
7. 11 Frame	70	57.06
8. 11 Sequence	75	61.00
9. 11 Whole	77	60.16
	745	

** Significant at .01 Level of Confidence.

TABLE 39

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X METHODS VARIABLES -- TREATMENT SESSION

(Data shown in parentheses are Least Significant Difference.)

Grades X Methods	$\bar{X}$	$\bar{X}$-3#	$\bar{X}$-6	$\bar{X}$-2	$\bar{X}$-5	$\bar{X}$-1	$\bar{X}$-4	$\bar{X}$-9	$\bar{X}$-8
7. 11 Frame	68.38	22.45** (3.65)	17.44** (3.85)	16.28** (3.68)	13.31** (3.58)	10.66** (3.43)	6.80** (3.63)	5.99** (3.73)	3.92** (3.76)
8. 11 Sequence	64.46	18.53** (3.60)	13.52** (3.78)	12.36** (3.60)	9.39** (3.50)	6.74** (3.35)	2.88* (2.69)	2.07 (2.77)	
9. 11 Whole	62.39	16.46** (3.58)	11.45** (3.76)	10.29** (3.58)	7.32** (3.47)	4.67** (3.33)	.81 (2.67)		
4. 7-8 Frame	61.58	15.65** (3.47)	10.64** (3.65)	9.48** (3.47)	6.51** (3.35)	3.86** (3.22)			
1. 5-6 Frame	57.72	11.79** (3.25)	6.78** (3.46)	5.62** (3.28)	2.65* (2.38)				
5. 7-8 Sequence	55.07	9.14** (3.39)	4.13** (3.60)	2.97* (2.59)					
2. 5-6 Sequence	52.10	6.17** (3.52)	1.16 (2.81)						
6. 7-8 Whole	50.94	5.01** (3.68)							
3. 5-6 Whole	45.93								

The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence

sequence group was significantly greater than those for the frame, sequence, and whole methods in *grade seven-eight* and *grade five-six*. Although the adjusted mean score for the whole method in the eleventh grade was not significantly different from the one for the frame method for the seventh-eighth grade group, it was significantly better than the scores for the sequence and whole methods groups in the seventh-eighth grade and the frame, sequence, and whole methods groups in the fifth-sixth grade. There was no significant difference between the sequence and whole methods in grade eleven. The only other non-significant interaction occurred between the sequence method (grades five-six) and the whole method (grades seven-eight). The scores for the *frame method* in grades seven-eight and five-six were significantly higher than those for the *sequence and whole methods* in grades seven-eight and five-six. The seventh-eighth grade *sequence* group was significantly better than the *whole* method group for grades seven-eight and five-six. All methods and grades groups had adjusted mean scores which were greater than the score for the whole method of presentation in the fifth-sixth grade group.

In the *delayed knowledge of results testing session* (Table 40) and in the *retention testing session* (Table 41), grade levels again ranked in a grouped order: first, all methods groups in *grade eleven*; second, all methods groups in *grade seven-eight*; and third, all methods groups in *grade five-six*. Methods groups in both sessions appeared in random order within grade levels. Overall, grade levels were probably responsible for the significant differences which occurred in adjusted mean scores.

TABLE 40

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X METHODS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Data shown in parentheses are Least Significant Differences.)

Grades X Methods	$\overline{X}$	$\overline{X}$-3[#]	$\overline{X}$-1	$\overline{X}$-2	$\overline{X}$-4	$\overline{X}$-6	$\overline{X}$-5	$\overline{X}$-7	$\overline{X}$-8
9. 11 Whole	67.10	13.61** (3.94)	9.51** (3.67)	8.67** (3.97)	7.37** (3.89)	6.90** (4.15)	6.09** (3.84)	.31 (3.11)	.22 (2.97)
8. 11 Sequence	66.88	13.39** (3.97)	9.29** (3.72)	8.45** (3.99)	7.15** (3.91)	6.68** (4.18)	5.87** (3.86)	.09 (3.15)	
7. 11 Frame	66.79	13.30** (4.05)	9.20** (3.77)	8.36** (4.07)	7.06** (3.99)	6.59** (4.24)	5.78** (3.94)		
5. 7-8 Sequence	61.01	7.52** (3.76)	3.42* (2.64)	2.58 (2.87)	1.28 (2.80)	.81 (3.01)			
6. 7-8 Whole	60.20	6.71** (4.07)	2.61 (2.90)	1.77 (3.11)	.47 (3.05)				
4. 7-8 Frame	59.73	6.24** (3.81)	2.14 (2.70)	1.30 (2.91)					
2. 5-6 Sequence	58.43	4.94** (3.89)	.84 (2.74)						
1. 5-6 Frame	57.59	4.10** (3.59)							
3. 5-6 Whole	53.49								

[#] The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Signigicant at .01 Level of Confidence.

TABLE 41

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X METHODS VARIABLES -- RETENTION TESTING SESSION

(Data shown in parentheses are Least Significant Differences.)

Grades X Methods	$\bar{X}$	$\bar{X}$-3#	$\bar{X}$-1	$\bar{X}$-2	$\bar{X}$-5	$\bar{X}$-6	$\bar{X}$-4	$\bar{X}$-7	$\bar{X}$-9
8. 11 Sequence	61.00	14.58** (3.84)	12.02** (3.59)	11.46** (3.86)	10.31** (3.73)	9.52** (4.02)	8.93** (3.78)	3.94* (3.03)	.84 (2.95)
9. 11 Whole	60.16	13.74** (3.81)	11.18** (3.56)	10.62** (3.84)	9.47** (3.71)	8.68** (3.99)	8.09** (3.76)	3.10* (3.01)	
7. 11 Frame	57.06	10.64** (3.89)	8.08** (3.64)	7.52** (3.91)	6.37** (3.81)	5.58** (4.11)	4.99** (3.86)		
4. 7-8 Frame	52.07	5.65** (3.71)	3.09* (2.60)	2.53 (2.81)	1.38 (2.72)	.59 (2.95)			
6. 7-8 Whole	51.48	5.06** (3.94)	2.50 (2.80)	1.94 (2.99)	.79 (2.91)				
5. 7-8 Sequence	50.69	4.27** (3.63)	1.71 (2.54)	1.15 (2.77)					
2. 5-6 Sequence	49.54	3.12* (2.85)	.56 (2.66)						
1. 5-6 Frame	48.98	2.56 (2.64)							
3. 5-6 Whole	46.42								

The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

Although in the delayed knowledge of results testing session, there were no significant differences in scores within grade eleven, the higher adjusted means for the three methods groups in grade eleven differed significantly (.01) from the adjusted means of the methods groups in grades seven-eight and five-six. All of the scores for the seventh-eighth grade methods groups and the sequence and frame methods groups for grade five-six were significantly superior (.01) to the score for the fifth-sixth grade, whole method group. The seventh-eighth grade group for the sequence method also had a significantly (.05) higher mean score than the fifth-sixth grade group for the frame method. All other interactions between scores for grades seven-eight and five-six in this session were non-significantly different.

The only significant difference (.05) within grades five-six in the retention testing session was the adjusted mean for the sequence method which ranked over the one for the whole method. All three methods groups in grade seven-eight also ranked over the fifth-sixth grade, whole method group. The only other difference of any significance between groups was that the frame method group of grade seven-eight ranked over the frame method group of grade five-six. In grade eleven the adjusted means for the sequence, whole, and frame methods all ranked significantly (.01) higher than those for the methods groups (frame, whole, and sequence) in grade seven-eight and higher than those for the methods groups (sequence, frame, and whole) in grade five-six. Although in grade eleven the adjusted means for the sequence and whole methods were significantly better (.05) than the adjusted mean for the *frame method*, there was no significant difference between the scores for the sequence and whole methods.

The difference between the lowest and highest adjusted mean scores in the *treatment session* was on an average of 8.35 points greater than the difference between the lowest and highest scores in the delayed knowledge of results testing session and in the retention testing session.

In observing the increase in adjusted mean scores which occurred from the treatment session to the *delayed knowledge of results testing session*, it is interesting to note that the *whole method* groups for each grade evidenced a greater gain than did the *sequence method* groups in each grade. The frame method groups actually showed a slight decrease in their adjusted mean scores -- more in grades eleven and seven-eight than in grade five-six.

The amount of material forgotten in the three weeks between the treatment session and the *retention testing session* (as indicated by adjusted mean scores in the retention testing session) was least for the whole method groups and most for the frame method groups in each grade. The frame method groups, however, obtained the highest scores in the treatment session; whereas, the whole method groups obtained the lowest scores. Grade five-six, regardless of the method used, experienced less forgetting than any other grade; the eleventh grade groups forgot the most, but since they had initially learned the most, they still retained more than the groups for the other grades.

Grades x Methods x Results

For each grade level used in this study, students were randomly assigned by classes to view a filmstrip by one of three methods of presentation and for each they were divided into control and experimental groups. The experimental groups received immediate knowledge of results and the control groups did not (treatment session). Both groups received delayed knowledge of results on the following day (delayed knowledge of results testing session), and approximately three weeks later they were tested for retention (retention testing session) using the same criterion measure. Table 42 for the treatment session, Table 43 for the delayed knowledge of results testing session, and Table 44 for the retention testing session show significant (.01) F ratios, indicating there were significant interrelationships among the eighteen sub-groups in each session.

Analysis of the Data for the Treatment Session

When the adjusted mean scores of all the variables for the treatment session were compared (Table 45), it was found that grade levels were a significant factor in only some of the cases. Methods of presentation (especially the frame method) played a predominate role in influencing the grade level variables. The adjusted means of the control and experimental groups for the frame method were not significantly different in any case within the different grade levels.

Although, with one exception (experimental, whole method group), the scores of the various groups for grade eleven maintained their rank position over the scores for the other grade groups, those who

TABLE 42

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Methods X Results	17	33329.14	1960.54	27.06**
Within	725	52529.21	72.45	
Total	742	86064.67		

Treatment: Grades X Methods X Results	N	Adjusted $\overline{X}$
1. 5-6 Frame IK+	55	56.51
2. 5-6 Frame NK++	56	58.91
3. 5-6 Sequence IK	36	52.49
4. 5-6 Sequence NK	45	51.71
5. 5-6 Whole IK	36	42.50
6. 5-6 Whole NK	47	48.53
7. 7-8 Frame IK	44	61.72
8. 7-8 Frame NK	43	61.42
9. 7-8 Sequence IK	45	56.25
10. 7-8 Sequence NK	48	53.98
11. 7-8 Whole IK	31	54.68
12. 7-8 Whole NK	37	47.77
13. 11 Frame IK	36	67.28
14. 11 Frame NK	34	69.56
15. 11 Sequence IK	34	63.64
16. 11 Sequence NK	41	65.23
17. 11 Whole IK	38	60.60
18. 11 Whole NK	39	64.17
	745	

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

7

TABLE 43

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Methods X Results	17	15834.68	931.45	10.46**
Within	725	64540.17	89.02	
Total	742	80581.16		

Treatment: Grades X Methods X Results	N	Adjusted $\bar{X}$
1. 5-6 Frame IK+	55	58.19
2. 5-6 Frame NK++	56	57.06
3. 5-6 Sequence IK	36	61.90
4. 5-6 Sequence NK	45	55.54
5. 5-6 Whole IK	36	53.35
6. 5-6 Whole NK	47	53.55
7. 7-8 Frame IK	44	62.99
8. 7-8 Frame NK	43	56.40
9. 7-8 Sequence IK	45	61.91
10. 7-8 Sequence NK	48	60.22
11. 7-8 Whole IK	31	61.45
12. 7-8 Whole NK	37	59.07
13. 11 Frame IK	36	66.22
14. 11 Frame NK	34	67.37
15. 11 Sequence IK	34	68.90
16. 11 Sequence NK	41	65.31
17. 11 Whole IK	38	67.02
18. 11 Whole NK	39	67.20
	745	

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 44

SUMMARY OF RESULTS BASED ON AN ANALYSIS OF COVARIANCE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- RETENTION TESTING SESSION

(Adjusting variables were science achievement test and IQ.)

Source	df	SS	MS	F
Grades X Methods X Results	17	16879.77	992.93	11.76**
Within	725	61203.35	84.42	
Total	742	78289.43		

Treatment: Grades X Methods X Results	N	Adjusted $\overline{X}$
1. 5-6 Frame IK+	55	49.59
2. 5-6 Frame NK++	56	48.36
3. 5-6 Sequence IK	36	50.98
4. 5-6 Sequence NK	45	48.33
5. 5-6 Whole IK	36	46.14
6. 5-6 Whole NK	47	46.62
7. 7-8 Frame IK	44	53.66
8. 7-8 Frame NK	43	50.43
9. 7-8 Sequence IK	45	50.86
10. 7-8 Sequence NK	48	50.54
11. 7-8 Whole IK	31	53.67
12. 7-8 Whole NK	37	49.63
13. 11 Frame IK	36	55.66
14. 11 Frame NK	34	58.58
15. 11 Sequence IK	34	60.93
16. 11 Sequence NK	41	61.14
17. 11 Whole IK	38	58.08
18. 11 Whole NK	39	62.24
	745	

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 45

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION
(Data shown in parentheses are Least Significant Differences)

Grades x Methods x Results	$\bar{X}$	$\bar{X}$-5#	$\bar{X}$-12	$\bar{X}$-6	$\bar{X}$-4	$\bar{X}$-3	$\bar{X}$-10	$\bar{X}$-11	$\bar{X}$-9	$\bar{X}$-1	$\bar{X}$-2	$\bar{X}$-17	$\bar{X}$-8	$\bar{X}$-7	$\bar{X}$-15	$\bar{X}$-18	$\bar{X}$-16	$\bar{X}$-13
14. 11 Frame NK^{++}	69.56	27.06** (5.41)	21.79** (5.35)	21.03** (5.07)	17.85** (5.10)	17.07** (5.41)	15.58** (5.04)	14.88** (5.61)	13.31** (5.10)	13.05** (4.89)	10.65** (4.87)	8.96** (5.54)	8.14** (5.15)	7.84** (5.12)	5.92** (5.46)	5.39** (5.30)	4.33* (3.94)	2.28 (4.08)
13. 11 Frame IK^{+}	67.28	24.78** (5.33)	19.51** (5.27)	18.75** (4.99)	15.57** (5.02)	13.79** (5.33)	13.30** (4.96)	12.60** (5.54)	11.01** (5.02)	10.77** (4.79)	8.37** (4.79)	6.68** (5.25)	5.86** (5.07)	5.56** (5.04)	3.64 (4.08)	3.11 (3.94)	2.05 (3.86)	
16. 11 Sequence NK	65.23	22.73** (5.12)	17.46** (5.10)	16.70** (4.79)	13.52** (4.86)	12.74** (5.12)	11.25** (4.76)	10.55** (5.38)	8.98** (4.86)	8.72** (4.63)	6.32** (4.60)	4.63* (3.82)	3.81* (3.70)	3.51 (3.68)	1.59 (3.94)	1.06 (3.78)		
18. 11 Whole NK	64.17	21.67** (5.22)	16.40** (5.17)	15.64** (4.86)	12.46** (4.91)	11.68** (5.22)	10.19** (4.84)	9.49** (5.43)	7.92** (4.91)	7.66** (4.68)	5.26** (4.68)	3.57 (3.86)	2.75 (3.74)	2.45 (3.72)	.53 (4.00)			
15. 11 Sequence IK	63.64	21.14** (5.41)	15.87** (5.35)	15.11** (5.07)	11.93** (5.10)	11.15** (5.41)	9.66** (5.04)	8.96** (5.61)	7.39** (5.10)	7.13** (4.89)	4.73* (3.68)	3.04 (4.18)	2.22 (3.88)	1.92 (3.86)				
7. 7-8 Frame IK	61.72	19.22** (5.04)	13.95** (5.02)	13.19** (4.71)	10.10** (4.73)	9.23** (5.04)	7.74** (4.68)	7.04** (5.30)	5.47** (4.73)	5.21** (4.52)	2.81 (3.41)	1.12 (3.76)	.30 (3.64)					
8. 7-8 Frame NK	61.42	18.92** (5.07)	13.65** (5.04)	12.89** (4.73)	9.71** (4.79)	8.93** (5.07)	7.44** (4.63)	6.74** (5.33)	5.17** (4.79)	4.91** (4.55)	2.51 (3.43)	.82 (3.78)						
17. 11 Whole IK	60.60	18.10** (5.25)	12.83** (5.22)	12.07** (4.91)	8.89** (4.96)	8.11** (5.25)	6.62** (4.88)	5.92** (5.46)	4.35* (3.74)	4.09* (3.58)	1.69 (3.56)							
2. 5-6 Frame NK	58.91	16.41** (4.58)	11.14** (4.73)	10.38** (4.42)	7.20** (4.47)	6.42** (4.58)	4.93** (4.39)	4.23* (3.80)	2.66 (3.37)	2.40 (3.21)								
1. 5-6 Frame IK	56.51	14.01** (4.79)	8.74** (4.76)	7.98** (4.44)	4.80** (4.50)	4.02* (3.62)	2.53 (3.33)	1.83 (3.80)	.26 (3.39)									
9. 7-8 Sequence IK	56.25	13.75** (5.02)	8.48** (4.99)	7.72** (4.68)	4.54* (3.56)	3.76 (3.78)	2.27 (3.52)	1.57 (3.98)										
11. 7-8 Whole IK	54.68	12.18** (5.57)	6.91** (5.49)	6.15** (5.20)	2.97 (3.98)	2.19 (4.20)	.70 (3.90)											
10. 7-8 Sequence NK	53.98	11.48** (4.96)	6.21** (4.91)	5.45** (4.60)	2.27 (3.52)	1.49 (3.74)												
3. 5-6 Sequence IK	52.49	9.99** (5.33)	4.72* (3.98)	3.96* (3.76)	.78 (3.78)													
4. 5-6 Sequence NK	51.71	9.21** (5.02)	3.94* (3.76)	3.18 (3.54)														
6. 5-6 Whole NK	48.53	6.03** (4.99)	.76 (3.72)															
12. 7-8 Whole NK	47.77	5.27** (5.27)																
5. 5-6 Whole IK	42.50																	

The adjusted mean for this group is subtracted from the adjusted means of those above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

received no knowledge of results obtained better scores than those who received immediate knowledge of results. The adjusted mean score of the control, frame method group in grade eleven was even significantly superior to all the scores for the other grade x method x results groups with the exception of the experimental, frame method group in the same grade. Both of the scores for the experimental and control frame method groups in grade eleven were significantly higher (.01) than those of the experimental and control frame method groups in grade seven-eight.

There were no significant differences in adjusted mean scores due to knowledge of results variables within any of the grade groups for the sequence methods. In the whole method groups, however, the adjusted mean for the seventh-eighth grade group which received immediate knowledge of results was significantly higher (.01) than the adjusted mean score for the seventh-eighth grade group which received no knowledge of results; whereas, in the fifth-sixth grade the adjusted mean for the no knowledge of results, whole method group was significantly higher than the one for the immediate knowledge of results group.

The adjusted mean scores of the whole method groups, both experimental and control, in grades five-six and the score of the control, whole method group in grade seven-eight were at the bottom of the rank order distribution of scores. All groups had scores which were significantly greater, at the .01 level of confidence, than the score for the whole method group (in grade five-six) which received immediate knowledge of results. When the adjusted means of the control, whole method groups in grades five-six and seven-eight, were compared, grade level differences were not found to be a significant factor.

The score of the sequence method group (in grades five-six) which received immediate knowledge of results was significantly higher (.05) than the score of the whole method group (in grade five-six) which did not receive knowledge of results. There was no significant difference, however, between the adjusted mean scores of the two method groups (sequence and whole) when knowledge of results was not given to both groups. The score of the immediate knowledge of results, sequence method group in grade five-six was not significantly different from the score of the same group for grade seven-eight. However, the difference was significantly different when the adjusted mean score for the immediate knowledge of results, sequence method group in grade seven-eight was compared to the score for the no knowledge of results, sequence method group in grade five-six. This did not hold true when the score of the same seventh-eighth grade group was compared to the score for the sequence method of grade five-six which also received immediate knowledge of results.

Those groups which received immediate knowledge of results for each method in grade seven-eight made higher adjusted mean scores than those which received no knowledge of results; the difference, however, was significant (.01) only for the whole method group. This ranking of the experimental group over the control group did not hold true in grade eleven and in grade five-six, except for the sequence method in grade five-six.

Analysis of the Data for the Delayed Knowledge of Results Testing Session

For the delayed knowledge of results testing session, (Table 46) grade eleven had higher adjusted mean scores in all cases than grades seven-eight and five-six. The scores for the various methods groups of both the experimental and control groups within grade eleven, however, did not differ from each other significantly. The experimental groups for the sequence and whole methods in grade eleven evidenced the greatest gains (over the treatment session) in adjusted mean scores.

In grades seven-eight and five-six methods variables and knowledge of results variables become more important. In grade seven-eight the experimental groups all achieved higher adjusted mean scores than the control groups, significantly different (.01), however, for the frame method groups only. The control groups for the sequence and whole methods in grade seven-eight evidenced a greater increase in their adjusted mean scores from the treatment session to the delayed knowledge of results testing session than did any other group.

In grade five-six the adjusted mean scores of both the experimental, sequence method group and the experimental, frame method group ranked higher than the scores for the control groups. The difference, however, was significant only for the sequence method group. The score of the whole method group in the fifth-sixth grade which had received immediate knowledge of results was on the bottom for all three sessions. For the delayed knowledge of results testing session, the scores of the experimental groups for the sequence and frame methods

TABLE 46

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION
(Data shown in parentheses are Least Significant Differences.)

Grades x Methods x Results	$\bar{X}$	$\bar{X}$-5#	$\bar{X}$-6	$\bar{X}$-4	$\bar{X}$-8	$\bar{X}$-2	$\bar{X}$-1	$\bar{X}$-12	$\bar{X}$-10	$\bar{X}$-11	$\bar{X}$-3	$\bar{X}$-9	$\bar{X}$-7	$\bar{X}$-16	$\bar{X}$-13	$\bar{X}$-17	$\bar{X}$-18	$\bar{X}$-14
15. 11 Sequence IK*	68.90	15.55** (5.99)	15.35** (5.60)	13.36** (5.65)	12.50** (5.73)	11.84** (5.39)	10.71** (5.42)	9.[illegible]** (5.94)	8.6[illegible]** (5.57)	7.45** (6.22)	7.00** (5.99)	6.99** (5.65)	5.91** (5.68)	3.59 (4.38)	2.68 (4.52)	1.88 (4.46)	1.70 (4.42)	1.53 (4.58)
14. 11 Frame NK**	67.37	14.02** (5.99)	13.82** (5.60)	11.83** (5.65)	10.97** (5.73)	10.31** (5.39)	9.18** (5.42)	8.30** (5.94)	7.15** (5.57)	5.92* (4.22)	5.47* (4.52)	5.46* (4.26)	4.38* (4.28)	2.06 (4.38)	1.15 (4.52)	.35 (4.46)	.17 (4.42)	
18. 11 Whole NK	67.20	13.85** (5.78)	13.65** (5.39)	11.66** (5.44)	10.80** (5.52)	10.14** (5.18)	9.01** (5.21)	8.13** (5.75)	6.98** (5.34)	5.75* (4.54)	5.30* (4.36)	5.29* (4.10)	4.21* (4.14)	1.89 (4.20)	.98 (4.36)	.18 (4.28)		
17. 11 Whole IK	67.02	13.67** (5.80)	13.47** (5.44)	11.48** (5.49)	10.62** (5.54)	9.96** (5.21)	8.83** (5.23)	7.95** (5.78)	6.80** (5.41)	5.57* (4.56)	5.12* (4.38)	5.11* (4.14)	4.03 (4.16)	1.71 (4.22)	.80 (4.38)			
13. 11 Frame IK	66.22	12.87** (5.88)	12.67** (5.52)	10.68** (5.57)	9.82** (5.62)	9.16** (5.31)	8.02** (5.31)	7.15** (5.86)	6.00** (5.49)	4.77* (4.62)	4.32 (4.44)	4.31* (4.20)	3.23 (4.27)	.91 (4.30)				
16. 11 Sequence NK	65.31	11.96** (5.70)	11.76** (5.31)	9.77** (5.39)	8.91** (5.44)	8.25** (5.10)	7.12** (5.13)	6.24** (5.65)	5.09* (4.00)	3.86 (4.50)	3.41 (4.70)	3.40 (4.06)	2.32 (4.08)					
7. 7-8 Frame IK	62.99	9.64** (5.60)	9.44** (5.21)	7.45** (5.26)	6.59** (5.31)	5.93** (5.00)	4.80* (3.78)	3.92 (4.18)	2.77 (3.92)	1.54 (4.42)	1.09 (4.22)	1.08 (3.98)						
9. 7-8 Sequence IK	61.91	8.56** (4.91)	8.36** (5.18)	6.37** (5.23)	5.51** (5.29)	4.85* (3.74)	3.72 (3.76)	2.84 (4.16)	1.69 (3.90)	.46 (4.40)	.01 (3.70)							
3. 5-6 Sequence IK	61.90	8.55** (5.88)	8.35** (5.52)	6.36** (5.57)	5.50* (4.24)	4.84* (4.02)	3.71 (4.02)	2.83 (4.42)	1.68 (4.14)	.45 (4.62)								
11. 7-8 Whole IK	61.45	8.10** (6.12)	7.90** (5.76)	5.91** (5.83)	5.05* (4.44)	4.39* (4.20)	3.26 (4.22)	2.38 (4.60)	1.23 (4.32)									
10. 7-8 Sequence NK	60.22	6.87** (5.49)	6.67** (5.10)	4.68* (3.90)	3.82 (3.94)	3.16 (3.68)	2.03 (3.68)	1.15 (4.10)										
12. 7-8 Whole NK	59.07	5.72* (4.42)	5.52** (5.46)	3.53 (4.16)	2.67 (4.22)	2.01 (3.98)	.88 (4.00)											
1. 5-6 Frame IK	58.19	4.84* (4.02)	4.64* (3.70)	3.65 (3.76)	1.79 (3.80)	1.13 (3.54)												
2. 5-6 Frame NK	57.06	3.71 (4.02)	3.51 (3.70)	1.52 (3.76)	.66 (3.78)													
8. 7-8 Frame NK	56.40	3.05 (4.24)	2.85 (3.96)	.86 (4.00)														
4. 5-6 Sequence NK	55.54	2.19 (4.20)	1.99 (3.92)															
6. 5-6 Whole NK	53.55	.20 (4.16)																
5. 5-6 Whole IK	53.35																	

# The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

were significantly higher than this score for the whole method group in the fifth-sixth grade; in the retention testing session, only the score of the sequence method group remained significantly higher. The experimental groups of grade five-six evidenced greater gains over the adjusted mean scores obtained in the treatment session than did the control groups.

The adjusted mean score of the frame method group which received immediate knowledge of results (in grade seven-eight) was significantly higher (.01) than the score for the frame method group which received no knowledge of results in the same grade. The score of this experimental, frame method group was also significantly superior to all of the scores for the fifth-sixth grade groups with the exception of the sequence method group which received immediate knowledge of results.

The experimental, sequence method group for the fifth-sixth grade had an adjusted mean score comparable to the same group in grade seven-eight. The adjusted mean of this experimental, sequence method group of the fifth-sixth grade was observed as being among the scores for the seventh-eighth grade groups. The control, frame method group was the only seventh-eighth grade group that had a score which was significantly different (lower) from the adjusted mean of the above fifth-sixth grade group. Even though the score of this experimental, sequence method group of the fifth-sixth grade ranked higher than the score of the experimental, frame method group in the fifth-sixth grade, it did not rank significantly higher.

In the experimental groups for grade seven-eight the adjusted mean scores of the frame and whole methods groups were significantly higher than the scores for the same groups in the fifth-sixth grade. In the *control* groups for grade seven-eight the scores of the sequence and whole methods were significantly higher than the scores for the same groups in the fifth-sixth grade.

In *grade eleven*, the adjusted means for the immediate knowledge of results group for the sequence method and the no knowledge of results groups for the frame and whole methods were significantly superior to all the adjusted means for the *seventh-eighth grade* groups. The scores of the experimental groups for the *frame and whole methods* (*grade eleven*) were not significantly different from the score of the experimental group for the *frame method* in *grade seven-eight*. The adjusted mean score of the immediate knowledge of results group for the *frame method* in *grade eleven* was also non-significantly different from the score of the experimental group for the *sequence method* in *grade five-six*. The scores of the control group for the sequence method (*grade eleven*) were non-significantly different from the scores for the experimental methods groups in *grade seven-eight*.

Analysis of the Data for the Retention Testing Session

The retention phase (Table 47) shows that the scores for all of the methods x results groups in grade eleven maintain their rank order positions over the scores for methods x results groups in grade seven-eight and grade five-six. Methods variables and knowledge of results variables had a greater effect than grade level variables on the order in which the groups appear for grades seven-eight and five-six. In this session the adjusted mean of the immediate knowledge of results,

TABLE 47

ADJUSTED MEAN SCORES FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES -- RETENTION TESTING SESSION
(Data shown in parentheses are Least Significant Differences.)

Grades x Methods x Results	$\bar{X}$	$\bar{X}$-5#	$\bar{X}$-6	$\bar{X}$-4	$\bar{X}$-2	$\bar{X}$-1	$\bar{X}$-12	$\bar{X}$-8	$\bar{X}$-10	$\bar{X}$-9	$\bar{X}$-3	$\bar{X}$-7	$\bar{X}$-11	$\bar{X}$-13	$\bar{X}$-17	$\bar{X}$-14	$\bar{X}$-15	$\bar{X}$-16
18. 11 Whole NK^{++}	62.24	16.10** (5.62)	15.62** (5.25)	13.91** (5.31)	13.88** (5.41)	12.65** (5.41)	12.61** (5.59)	11.81** (5.36)	11.70** (5.21)	11.38** (5.31)	11.26** (5.62)	8.58** (5.33)	8.57** (5.86)	6.58** (5.62)	4.16* (4.16)	3.66 (4.32)	1.31 (4.32)	1.10 (4.10)
16. 11 Sequence NK	61.14	15.00** (5.54)	14.52** (5.15)	12.81** (5.23)	12.78** (4.97)	11.55** (5.00)	11.51** (5.49)	10.71** (5.31)	10.60** (5.13)	10.28** (5.23)	10.16** (5.54)	7.48** (5.25)	7.47** (5.80)	5.48* (4.18)	3.06 (4.12)	2.56 (4.26)	.21 (4.26)	
15. 11 Sequence IK^{+}	60.93	14.79** (5.83)	14.31** (5.46)	12.60** (5.52)	12.57** (5.26)	11.34** (5.26)	11.30** (5.78)	10.50** (5.57)	10.39** (5.44)	10.07** (5.52)	9.95** (5.83)	7.27** (5.54)	7.26** (6.06)	5.27* (4.40)	2.85 (4.34)	2.35 (4.46)		
14. 11 Frame NK	58.58	12.44** (5.83)	11.96** (5.46)	10.25** (5.52)	10.22** (5.26)	8.99** (5.26)	8.95** (5.78)	8.15** (5.57)	8.04** (5.44)	7.72** (5.52)	7.60** (5.83)	4.92* (4.18)	4.91* (4.56)	2.92 (4.40)	.50 (4.34)			
17. 11 Whole IK	58.08	11.94** (5.67)	11.46** (5.28)	9.75** (5.33)	9.72** (5.08)	8.49** (5.10)	8.45** (5.62)	7.65** (5.41)	7.54** (5.28)	7.22** (5.33)	7.10** (5.67)	4.42* (4.04)	4.41 (4.44)	2.42 (4.28)				
13. 11 Frame IK	55.66	9.52** (5.75)	9.04** (5.36)	7.33** (5.41)	7.30** (5.15)	6.07** (5.18)	6.03** (5.41)	5.23* (4.14)	5.12* (4.04)	4.80* (4.08)	4.68* (4.34)	2.00 (4.10)	1.99 (4.50)					
11. 7-8 Whole IK	53.67	7.53** (5.96)	7.05** (5.62)	5.34* (4.28)	5.31* (4.10)	4.08 (4.10)	4.04 (4.48)	3.24 (4.32)	3.13 (4.22)	2.81 (4.28)	2.69 (4.50)	.01 (4.30)						
7. 7-8 Frame IK	53.66	7.52** (5.44)	7.04** (5.08)	5.33** (5.13)	5.30** (4.87)	4.07* (3.68)	4.03 (4.08)	3.23 (3.92)	3.12 (3.82)	2.80 (3.88)	2.68 (4.10)							
3. 5-6 Sequence IK	50.98	4.84* (4.34)	4.36* (4.04)	2.65 (4.08)	2.62 (3.90)	1.39 (3.97)	1.35 (4.30)	.55 (4.14)	.44 (4.04)	.12 (4.08)								
9. 7-8 Sequence IK	50.86	4.72* (4.08)	4.24* (3.82)	2.53 (3.86)	2.50 (3.64)	1.27 (3.66)	1.23 (4.06)	.43 (3.90)	.32 (3.80)									
10. 7-8 Sequence NK	50.54	4.40* (4.04)	3.92* (3.76)	2.21 (3.80)	2.18 (3.58)	.95 (3.58)	.91 (4.00)	.11 (3.84)										
8. 7-8 Frame NK	50.43	4.29* (4.14)	3.81 (3.86)	2.10 (3.90)	2.07 (3.68)	.84 (3.70)	.80 (4.10)											
12. 7-8 Whole NK	49.63	3.49 (4.30)	3.01 (4.02)	1.30 (4.06)	1.27 (3.88)	.04 (3.88)												
1. 5-6 Frame IK	49.59	3.45 (3.92)	2.97 (3.62)	1.26 (3.66)	1.23 (3.45)													
2. 5-6 Frame NK	48.36	2.22 (3.90)	1.74 (3.60)	.03 (3.64)														
4. 5-6 Sequence NK	48.33	2.19 (4.08)	1.71 (3.82)															
6. 5-6 Whole NK	46.62	.48 (4.04)																
5. 5-6 Whole IK	46.14																	

# The adjusted mean for this group is subtracted from the adjusted means of those groups above it. The difference appears above the parentheses in each cell.

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

sequence method group for the fifth-sixth grade again appears among those adjusted mean scores for the seventh-eighth grade groups. All other adjusted means for the fifth-sixth grade groups are lower than those for the seventh-eighth grade groups.

Within *grade eleven* the control (NK) groups for each method had higher adjusted mean scores. In the whole method the difference in scores was significant at the .05 level of confidence. In *grade seven-eight* the *immediate* knowledge of results groups evidenced higher adjusted mean scores than the *no* knowledge of results groups, although not significantly higher. In *grade five-six* the same was true as in grade seven-eight except for the adjusted mean of the experimental group for the whole method which was again (for the third time) on the bottom.

The adjusted means of the *whole method* groups (control and experimental) were the poorest for grade five-six, but for grade eleven (control) and for grade seven-eight (experimental) they were the best. For grade five-six the adjusted mean scores for the *sequence and frame methods* groups were higher than the scores for the *whole method* groups. The only score for the methods x results combination in grade five-six which was significantly higher than the scores for any of the other groups was the one for the experimental, *sequence method* group which was significantly higher, at the .05 level of confidence, from both (experimental and control) groups for the *whole method*. The scores for the two groups (experimental and control) for the *sequence method in grade seven-eight* were also significantly superior (.05) to those for the two *whole method groups in the fifth-sixth grade*. The adjusted mean scores of the immediate knowledge of results groups for the *whole and frame methods* in the *seventh-eighth grade* were significantly greater than the adjusted mean scores for *all fifth-sixth grade* groups except (1) the experimental, sequence method group and (2) the experimental frame method group. The score for the sequence method group in the *fifth-sixth grade* which received immediate knowledge of results was significantly better than the scores for the sequence method groups (experimental and control) in the *seventh-eighth grade*.

When the adjusted mean score of the experimental groups for the sequence method in *grade eleven* was compared with the adjusted means of the sequence method groups in *grades five-six and seven-eight*, it was found that the adjusted mean for grade eleven was significantly higher, at the .01 level of confidence. However, the scores of the experimental groups for the frame and whole methods in the *eleventh grade* were non-significantly different from the scores of the experimental groups for the frame and whole methods in the *seventh-eighth grade*. Within grade eleven both the experimental and control groups for the *sequence method* produced significantly higher (.05) scores than the score of the experimental group for the *frame method*. The score of the experimental group for the *whole method*, although higher, was not significantly different from the score of the experimental group for the *frame method*.

A Combined Analysis of the Data for all Three Sessions

The difference between the lowest and highest adjusted mean scores in the treatment session was more than ten points greater than the difference between the lowest and highest adjusted mean scores in the delayed knowledge of results and retention testing session. The range of adjusted mean scores in the delayed knowledge of results testing session was less than one point different from the range of scores in the retention testing session. The highest adjusted mean score in the retention testing session was 7.32 points lower than the highest score earned in the treatment session; however, the lowest adjusted mean score in the retention testing session was 3.64 points higher than the lowest score in the treatment session.

Grades five-six and seven-eight achieved greater gains in adjusted mean scores from the treatment session to the delayed knowledge of results testing session than did grade eleven. The whole method groups evidenced the greatest gain in scores and the frame method groups the least. The no knowledge of results groups in all three grades for the frame method evidenced lower adjusted mean scores. The immediate knowledge of results group for the frame method evidenced a lower score only in grade eleven. The immediate knowledge of results groups in grades five-six and eleven evidenced the greater gains in adjusted mean scores (over the treatment session); whereas, in grade seven-eight the no knowledge of results groups (except for the frame method) evidenced the greater gains in scores.

The scores for the fifth-sixth grade groups in the retention testing session definitely did not drop proportionately (from the treatment session) as much as the scores for the seventh-eighth and eleventh grade groups. This may be due to the effect of the delayed knowledge of results testing session. The scores of the frame method groups showed the greatest drop and the whole method groups the least. The scores for the no knowledge of results groups indicated that all control groups forgot the most in grade five-six. The scores for the immediate knowledge of results groups indicated that they forgot the most in the sequence and whole methods groups in grade seven-eight but in the frame and whole methods groups in grade eleven.

A Summary Analysis of Adjusted Means

The following analysis of the adjusted mean scores obtained on the criterion measure for grades, methods, and results in the last three sessions reveals a number of trends within each session.

Treatment Session (Table 48). In the treatment session the frame method of filmstrip presentation was superior. The sequence method ranked second and the whole method third. The eleventh grade group definitely learned the most and the fifth-sixth grade group the least. There was practically no difference between the total adjusted means of the experimental and control groups. The control groups for the frame and whole methods in grade five-six obtained higher adjusted mean scores than the experimental groups; all control groups in grade eleven had higher scores. The experimental groups, however, in grade seven-eight had the highest scores. The greatest differences between the scores for the control and experimental groups were in the whole method groups.

Delayed Knowledge of Results Testing Session (Table 49). In the delayed knowledge of results testing session the rank position of the

TABLE 48

ADJUSTED MEANS FOR GRADE LEVEL VARIABLES, METHODS VARIABLES, AND KNOWLEDGE OF RESULTS VARIABLES -- TREATMENT SESSION

Methods	Results	GRADES			Total $\bar{X}$ Methods
		$\bar{X}$ 5-6	$\bar{X}$ 7-8	$\bar{X}$ 11	
1. Frame	IK[+]	56.51	61.72	67.28	61.91
	NK[++]	58.91	61.42	69.56	
2. Sequence	IK	52.49	56.25	63.64	56.95
	NK	51.71	53.98	65.23	
3. Whole	IK	42.50	54.68	60.60	52.78
	NK	48.53	47.77	64.17	
Total $\bar{X}$ Grades		52.40	56.19	65.15	
Total $\bar{X}$ Results					IK 57.24
					NK 57.66

[+] IK means Immediate knowledge of results (Experimental group).

[++] NK means No knowledge of results (Control group).

TABLE 49

ADJUSTED MEANS FOR GRADE LEVEL VARIABLES, METHODS VARIABLES, AND KNOWLEDGE OF RESULTS VARIABLES -- DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

Methods	Results	GRADES $\bar{X}$ 5-6	 $\bar{X}$ 7-8	 $\bar{X}$ 11		Total $\bar{X}$ Methods
1. Frame	IK[+]	58.19	62.99	66.22		60.81
	NK[++]	57.06	56.40	67.37		
2. Sequence	IK	61.90	61.91	68.90		61.96
	NK	55.54	60.22	65.31		
3. Whole	IK	53.35	61.45	67.02		59.93
	NK	53.55	59.07	67.20		
Total $\bar{X}$ Grades		56.56	60.33	66.99		
Total $\bar{X}$ Results					IK	62.15
					NK	59.81

[+] IK means Immediate knowledge of results (Experimental group).

[++] NK means No knowledge of results (Control group).

sequence method shifted from second (in the treatment session) to first place; the position of the frame method dropped to second place; and the position of the whole method remained in third place. The eleventh grade group retained (1 day) the most information and the fifth-sixth grade group the least. A difference in adjusted means for total results variables favored the immediate knowledge of results variable. The only times when the adjusted mean scores for the experimental groups were not higher than those for the control groups were in the whole method groups in grade five-six and in grade eleven. This difference, however, was not great. The greatest differences in scores favoring the immediate knowledge of results groups were in the scores of the sequence method group in grade five-six and the frame method group in grade seven-eight.

Retention Testing Session (Table 50). In the retention phase the sequence method again appears in first place; the whole method moves to second place; and the frame method shifts to third place. The difference in scores between the whole and frame methods, however, was less than one-half of a point. The eleventh grade group again retained (3 weeks) the most information and the fifth-sixth grade group the least. For all practical purposes the difference (.47) between the adjusted means for the experimental and control groups (total results) was insignificant. The scores of the control groups in grade eleven were higher than those of the experimental groups. The greatest differences in adjusted mean scores between the experimental and control groups were in the scores of the whole method groups in grades seven-eight and eleven.

TABLE 50

ADJUSTED MEANS FOR GRADE LEVEL VARIABLES, METHODS VARIABLES, AND KNOWLEDGE OF RESULTS VARIABLES -- RETENTION TESTING SESSION

Methods	Results	GRADES				Total $\bar{X}$ Methods
		$\bar{X}$ 5-6	$\bar{X}$ 7-8	$\bar{X}$ 11		
1. Frame	IK[+]	49.59	53.66	55.66		52.23
	NK[++]	48.36	50.43	58.58		
2. Sequence	IK	50.98	50.86	60.93		53.44
	NK	48.33	50.54	61.14		
3. Whole	IK	46.14	53.67	58.08		52.40
	NK	46.62	49.63	62.24		
Total $\bar{X}$ Grades		48.36	51.39	59.49		
Total $\bar{X}$ Results					IK	52.93
					NK	52.46

[+] IK means Immediate knowledge of results (Experimental group).

[++] NK means No knowledge of results (Control group).

Comparisons between the Three Sessions. The range between the adjusted mean scores for the three methods of presentation was greatest (9.13) in the treatment session and least (1.11) in the retention testing session with the difference in scores for the delayed knowledge of results testing session varying only slightly from the difference in scores for the retention testing session. Gains in the adjusted mean scores from the treatment session to the delayed knowledge of results session were observed in the sequence method group (5.01) and in the whole method group (6.15); a loss, however, was observed in the frame method group (-1.10). The frame method groups evidenced the greatest decrease (-9.68) in adjusted mean scores from the treatment session to the retention testing session, while the whole method groups evidenced the least decrease (-.38). The difference in total grade level scores was about the same for all three sessions. The eleventh grade group definitely learned and retained the most and the fifth-sixth grade group the least in all cases. In each session there was a greater difference in scores between grade eleven and grade seven-eight than between grade seven-eight and grade five-six. In comparing the scores within each grade level, one finds that grades five-six and seven-eight evidenced approximately the same gains (in adjusted means) from the treatment session to the delayed knowledge of results testing session. Their gains were more than the gain evidenced in grade eleven. Grade eleven evidenced the greatest decrease in adjusted mean scores from the treatment session to the retention testing session and grades five-six evidenced the least decrease.

Sources of Variations and Interaction Variance

In order to segregate the sources of variations and determine if the differences among the adjusted means owed their divergencies to methods, results, grades or to an interaction of any possible combination of these, an analysis of variance was made of adjusted mean scores. Thus any significant difference may be attributed to the proper source of variation.

Tables 51, 52, and 53 report the final factors and interactions which were found to be significant in the treatment session and in the delayed knowledge of results and retention testing sessions as a result of testing for interaction variance. Methods variables were significant only in the treatment session, knowledge of results variables in the delayed knowledge of results testing session, and grade level variables in all three sessions. After the systematic effects of methods, results, and grades were removed from the other combinations of data, the grades x results and the methods x grades combinations proved to be significant in the treatment session and in the retention testing session. The method x results x grades combination was only significant in the treatment session. The conclusion, therefore, is that these factors acted together and the variance cannot be attributed to either methods, results, or grades acting alone as was the case when significance occurred in the gross analysis of covariance but did not occur in the final analysis of variance.

TABLE 51

ANALYSIS OF VARIANCE OF ADJUSTED MEANS FOR THE TREATMENT SESSION

Sources of Variation	TREATMENT SESSION			
	df	SS	MS	F
Methods	2	10141.28	5070.64	70.27**
Results	1	33.50	33.50	.46
Grades	2	18895.76	9447.88	130.93**
Methods x Results	2	184.78	92.39	1.28
Grades x Results	2	1219.23	609.61	8.45**
Methods x Grades	4	2074.29	518.57	7.19**
Methods x Results x Grades	4	780.30	195.07	2.70*
Error	728	52529.22	72.16	
Total	745	85858.36		

* Significant at .05 Level of Confidence.

** Significant at .01 Level of Confidence.

TABLE 52

ANALYSIS OF VARIANCE OF ADJUSTED MEANS FOR THE DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

Sources of Variation	DELAYED KNOWLEDGE OF RESULTS TESTING SESSION			
	df	SS	MS	F
Methods	2	491.78	245.89	2.77
Results	1	1005.57	1005.57	11.34**
Grades	2	12390.26	6195.13	69.88**
Methods x Results	2	203.09	101.54	1.15
Grades x Results	2	208.52	104.26	1.18
Methods x Grades	4	753.78	188.44	2.13
Methods x Results x Grades	4	781.68	195.42	2.20
Error	728	64540.17	88.65	
Total	745	80374.85		

** Significant at .01 Level of Confidence.

TABLE 53

ANALYSIS OF VARIANCE OF ADJUSTED MEANS FOR THE RETENTION TESTING SESSION

Sources of Variation	RETENTION TESTING SESSION			
	df	SS	MS	F
Methods	2	216.12	108.06	1.29
Results	1	41.49	41.49	.49
Grades	2	14545.09	7272.55	86.50**
Methods x Results	2	14.66	7.33	.09
Grades x Results	2	772.53	386.26	4.59*
Methods x Grades	4	948.11	237.03	2.82*
Methods x Results x Grades	4	341.77	85.44	1.02
Error	728	61203.35	84.07	
Total	745	78083.12		

* Significant at .05 Level of Confidence

** Significant at .01 Level of Confidence

Chapter V

SUMMARY OF THE STUDY

Statement of the Problem

This study was an investigation of the effects (1) of two degrees of immediacy of knowledge of results and (2) of three methods of presentation on the retention of knowledge produced by a filmstrip. The methods involved the presentation of a filmstrip by three schedules: (1) frame-by-frame — each frame of the filmstrip was followed by one or more test items over that frame, (2) sequence — each logical unit of the filmstrip was followed by one or more test items over that sequence, and (3) whole — the entire filmstrip was followed by all of the test items. Half of the groups for each schedule knew if their response was correct immediately upon answering each test item (experimental group). The other half of the subjects received knowledge of results on the day following the presentations (control group). To assess retention, the writer readministered the criterion measure approximately three weeks after the presentation of the filmstrip.

Procedures

1. The revised version of the filmstrip entitled _Earth's Satellite_: _The Moon_ (SVE) was selected for use.

2. A comprehensive 80-item test was written to cover the content taught by the filmstrip. After validation, the verbal-pictorial

test was produced in filmstrip form by the Society for Visual Education in Chicago.

3. Copies of the information-conveying filmstrip and of the test filmstrip were cut up and mounted in single-frame slide mounts and then arranged into the three methods of presentation.

4. Subjects were drawn from the fifth-sixth, seventh-eighth, and eleventh grades of public schools and were randomly assigned within each grade-group to six different treatment groups.

5. Four different sessions were involved. The pre-treatment testing session was devoted to acquainting all of the students with the punchboard device by means of slides, practice exercises, and test items and to administering a science achievement test. The treatment session involved the presentation of the filmstrip by one of the three methods. No knowledge of results was employed for the control groups; immediate knowledge of results (i.e., each student would know immediately by how far the stylus went into the punchboard whether or not the response made to a test item was correct) was employed for the experimental groups. In the delayed knowledge of results testing session, which was on the day following the treatment session, the criterion measure was readministered and delayed knowledge of results was given to all groups, i.e., all students were informed of the correct response by the investigator, who announced the correct letter of the item and pointed to it on the screen and then underscored the answer (with the pointer light) as the students read it silently. For the retention testing session the criterion measure was repeated again as a measure of retention. This was done twenty to twenty-five days after the treatment session.

6. The data were treated by an analysis of covariance program with two covariants: science achievement test scores and intelligence quotients. If a significant F occurred, indicating that nonchance variations existed among the adjusted means, then further analysis was made by the Least Significant Difference method to determine which adjusted means were significant. Finally, an analysis of variance was used to determine whether differences among adjusted means owe their divergencies to methods variables, results variables, grade level variables or to an interaction of any of the possible combinations of these variables.

Results with Related Conclusions

The statement below of each null hypothesis is followed by the results and conclusions related to that hypothesis.

Hypothesis 1

> The frame and sequence methods of presenting a filmstrip are no more effective than the whole method for facilitating the learning or retention of the information contained in the filmstrip.

Significant differences in adjusted mean scores were observed in the presentation phase (treatment session) for the three different methods employed in this study. The frame method group produced the highest adjusted mean score, significantly higher than those for the sequence and whole methods groups. The sequence method group produced significantly higher adjusted mean scores than the whole method group. Since the methods of filmstrip presentation employed in this study do play a significant role in the amount of information learned, this portion of the null hypothesis must be rejected. One would conclude that the small - increment, frame-by-frame approach is definitely superior to the whole approach. The sequence (logical units of subject matter) presentation is also better than the whole method of presentation but not as good as the frame-by-frame approach.

In the delayed knowledge of results and retention testing sessions, which involved immediate (1 day) and long-term (3 weeks) retention, no significant differences were found among the adjusted means. Therefore, on the basis of the analysis in this study, one must accept the portion of the null hypothesis relating to retention.

Hypothesis 2

> Knowledge of results is no more effective than no knowledge of results for facilitating the learning or retention of information presented by a filmstrip.

In analyzing the effectiveness of knowledge of results by the analysis of covariance method, a non-significant difference between adjusted mean scores was observed in the treatment session. Hence, the portion of the null hypothesis which states that knowledge of results is no more effective than no knowledge of results for facilitating the learning of information presented by a filmstrip is accepted.

A significant difference between adjusted mean scores was observed in the delayed knowledge of results testing session only. Thus in this immediate retention phase (1 day), pupils having received immediate knowledge of results during the presentation of the filmstrip obtained significantly higher adjusted mean scores than those which had not received any knowledge of their results. Students in both the experimental and control groups appeared to profit from delayed knowledge of results but those who had already received immediate knowledge of results in the treatment session were the ones who obtained significantly higher scores in the delayed knowledge of results testing session. There was no significant difference in adjusted mean scores for retention after three weeks. Therefore, on the basis of the analysis in this study, one may reject, with reservations, the portion of the null hypothesis which indicated that knowledge of results has no effect on the retention of information presented by a filmstrip. One would conclude that, although immediate knowledge of results has some effect on immediate retention (1 day), immediate and delayed knowledge of results do not have a significant effect on long-term (3 weeks) retention.

Hypothesis 3

> Grade level differences have no significant effect on the learning or retention of information presented by a filmstrip.

Although the matter is not a major part of this study, differences attributable to grade levels were analyzed. In all sessions students in grade eleven earned significantly higher scores than students in grades seven-eight and five-six. Students in grade seven-eight also earned significantly higher scores than students in grade five-six. The greater differences in adjusted mean scores were between grade eleven and grade seven-eight. Thus both portions of the null hypothesis are rejected. One may conclude that the more advanced a student (in grade level) the more he will learn and retain from a filmstrip presentation.

Hypothesis 4

> There is no significant interaction (which facilitates the learning or retention of information contained in a filmstrip) between any of the following combinations of variables: knowledge of results or no knowledge of results and methods of presenting a filmstrip -- frame, sequence, whole.

An analysis of the data for the treatment session and the delayed knowledge of results and retention testing sessions revealed that no significant interactions exist between the combinations of knowledge of results variables and methods variables. On this basis, the null hypothesis is accepted. One may conclude that learning and retention of information presented by a filmstrip are not facilitated by combining these variables.

Hypothesis 5

> There is no significant interaction (which facilitates the learning or retention of information presented by a filmstrip) between any of the following combinations of variables: knowledge of results or no knowledge of results and grade levels — five-six, seven-eight, eleven.

The significant interactions which occurred in the treatment session and the retention testing session for the knowledge of results x grade levels combination revealed the same rank order distribution of scores for grade level variables. The adjusted mean scores for grade eleven were significantly higher than the scores for grades seven-eight and five-six. The adjusted mean scores for grade seven-eight were also significantly higher than those for grade five-six, except in the retention testing session where the adjusted mean of the control (NK) group for grade seven-eight was non-significant from that of the experimental (IK) group for grade five-six.

Within grades eleven and five-six, in the initial learning stage (treatment session), the students in the no knowledge of results groups earned significantly higher mean scores than the students in the immediate knowledge of results groups. Within grade seven-eight, however, the students in the immediate knowledge of results group earned the higher adjusted mean score. In the retention phase (3 weeks) the students in the no knowledge of results group for grade eleven retained significantly more information than those in the immediate knowledge of results group. In grade seven-eight the immediate knowledge of results group retained significantly more than the no knowledge of results group. No significant difference in adjusted mean scores was found between the experimental (IK) and control (NK) groups in grade five-six. The adjusted mean of the experimental group in the retention session, however, was higher than the control group; in the treatment session the score of the experimental group (grade five-six) was on the bottom. It appears that the relationship of knowledge of results variables within grade levels is somewhat inconsistent.

On the basis of the analysis in this study, one may reject both portions of the null hypothesis. One would conclude that in grade eleven knowledge of results does not facilitate learning or retention of information presented by a filmstrip; if anything, it interferes with learning and retention. In grades seven-eight and five-six, however, knowledge of results is generally helpful.

Hypothesis 6

> There is no significant interaction (which facilitates the learning or retention of information contained in a filmstrip) between any of the following combinations of variables: methods of presenting a filmstrip—frame, sequence, whole and grade levels—five-six, seven-eight, eleven.

Significant differences attributable to the interaction of methods and grade levels were observed in the presentation phase (treatment session) and in the retention phase (3 weeks). In the presentation phase, the adjusted mean score for the frame method group was significantly higher than the scores for the sequence and whole methods groups in grade eleven. Within grades seven-eight and five-six methods had more effect on learning than grade levels; that is, the frame method for grades seven-eight and five-six ranked first, the sequence method second (grades seven-eight and five-six), and the whole method third (grades seven-eight and five-six). Thus, the adjusted means of the frame method groups for the seventh-eighth and fifth-sixth grades were significantly higher than the adjusted means of the sequence method groups for the seventh-eighth and fifth-sixth grades. The adjusted mean of the sequence method group for the seventh-eighth grade was also significantly higher than the scores for the whole method groups in grades seven-eight and five-six. The adjusted mean of the sequence method group for the fifth-sixth grade was not significantly better than the adjusted mean of the whole method group for the seventh-eighth grade. Grade differences within methods were still evident in that the adjusted mean score of the seventh-eighth grade group for any particular method was significantly higher than that of the fifth-sixth grade group for the same method.

Although the score for the whole method group in grade eleven was not significantly greater than that for the frame method group in grade seven-eight, all other methods groups for grade eleven were significantly superior to those for grades seven-eight and five-six.

In the retention testing session the adjusted means for the eleventh grade groups again ranked significantly higher than those for the seventh-eighth and fifth-sixth grade groups, and the adjusted mean scores for the seventh-eighth grade groups ranked higher than the adjusted mean scores for the fifth-sixth grade groups; the differences were not all significant. Within grade eleven the adjusted mean scores for the sequence and whole methods groups were significantly higher than the one for the frame method group, and within grades five-six the adjusted mean score for the sequence method group was significantly higher than that for the whole method group.

On the basis of the analysis in this study, one may reject both portions of the null hypothesis. One would conclude (1) that methods of filmstrip presentation play a more important role in learning (regardless of the grade level) than in retention of information and (2) that the more advanced the student (in grade level), the more information he will retain, regardless of the method of filmstrip presentation.

Hypothesis 7

> There is no significant interaction (which facilitates the learning or retention of information contained in a filmstrip) between any of the following combinations of variables: knowledge of results or no knowledge of results, methods of presenting a filmstrip — frame, sequence, whole and grade levels — five-six, seven-eight, eleven.

Significant differences attributable to the interaction of knowledge of results variables x methods variables x grade level variables were observed in the treatment session only. Both methods and results variables affected the order in which grade level variables occurred. Students in both the experimental (IK) and control (NK) groups for the frame method in grade seven-eight obtained scores which ranked higher than those of the experimental group for the whole method in grade eleven. Also the students in both the experimental and control groups for the frame method in grade five-six ranked higher than the sequence and whole methods groups in grade seven-eight. In addition, the two fifth-sixth grade groups (experimental and control) for the sequence method ranked significantly higher, and the control group for the whole method ranked non-significantly higher than the control group of the whole method in grade seven-eight.

Within grade eleven, the adjusted mean score of the control group (NK) for the frame method was significantly higher than the adjusted mean scores of the control and experimental (IK) groups for the sequence method. In comparison to the whole method groups, the frame method groups (both control and experimental) had significantly higher adjusted mean scores. The adjusted mean score of the control group for the sequence method was also significantly higher than that of the experimental group for the whole method.

Within grade seven-eight, the frame method groups obtained significantly higher scores than the sequence and whole methods groups. The sequence method groups also obtained significantly higher scores than the control group for the whole method.

Within grade five-six, the adjusted means for the frame method groups again appeared significantly higher than those of the sequence and whole methods groups. The adjusted mean score of the experimental group for the sequence method was significantly superior to the adjusted means for both whole method groups (control and experimental); the score of the control group for the sequence method was significantly higher than that of only the experimental group for the whole method.

Significant relationships between knowledge of results variables and the whole method groups were observed in grades seven-eight and five-six. In grade seven-eight, students in the immediate knowledge of results group had significantly higher scores than students in the no knowledge of results group, but in grades five-six the reverse was true, i.e., students in the no knowledge of results group had significantly higher scores than students in the immediate knowledge of results group. Further analysis reveals (except in grades seven-eight) a greater number of favorable adjusted mean scores for the no knowledge of results groups.

On the basis of the analysis in this study, one may reject the portion of the null hypothesis related to the facilitation of learning but must accept the portion pertaining to retention. One would conclude that methods of filmstrip presentation play an important role in learning and that the effect of knowledge of results is not important. Also the higher the grade, the less effect other variables will have on the amount learned.

Hypothesis 8

> Immediate testing does not reduce the retention of information learned by the students; therefore, the continuity of a filmstrip is not adversely affected.

Significant differences were observed in only a few comparisons relating to retention. However, in analyzing the adjusted mean scores for the methods employed in this study one finds that the adjusted mean score for the sequence method group shifted from second place in the treatment session to first place in the delayed knowledge of results and retention testing sessions. The score for the frame method group shifted from first place in the treatment session to second place in the delayed knowledge of results testing session and to third place in the retention testing session. It appears that although the frame method group produced significantly greater results in the presentation phase, these differences do not hold up in the retention phase. The sequence method group, which produced significantly higher adjusted mean scores than the whole method group (but not as high as the frame method group) in the presentation phase had the highest adjusted mean scores in the retention phases.

In looking at the interactions of methods x results, the adjusted mean of the sequence method group, although not significantly different from the others, appears in first place for the delayed knowledge of results and retention testing sessions. In the methods x grade levels combination for the delayed knowledge of results testing session, the sequence method group ranked first in grades seven-eight and five-six. In considering long-term retention (3 weeks), the adjusted mean scores for the sequence and whole methods groups were significantly higher than the frame method group in grade eleven; whereas, in grade five-six the sequence method group had significantly higher scores than the whole method group. The interaction of methods x grades x results in the delayed knowledge of results testing session reveals that the experimental groups (IK) for the sequence method of grades eleven and five-six ranked first for their grade levels. In the retention testing session, only in the fifth-sixth grade did the experimental group for the sequence method stay in first place.

One may conclude from the above evidence that the sequence method is superior to the frame method in facilitating retention of information presented by a filmstrip. Grade differences also seem to be related to the amount of information which can be grouped together for effective presentation and retention; the frame-by-frame method appears to be too fragmentary, particularly for the upper grades. Therefore, a qualified rejection of the null hypothesis is in order.

Implications and Recommendations

1. The statistical evidence from the treatment session of this study suggests that when a filmstrip is first presented the students will learn more if the frame-by-frame or the sequence methods are used. Particularly is this true in the lower grades. Although the difference between adjusted means in the retention phases was non-significant for the different methods of presentation, the adjusted means for

the sequence method were higher than the adjusted means for the frame and whole methods. In the retention testing session for grade eleven, the sequence and whole methods groups were significantly higher than the frame method group. Thus, perhaps the frame method is too fragmentary for eleventh grade students. These findings raise the question of whether or not larger increments, involving presentations of organized meaningful material, followed by questions over that material, would not be as satisfactory in programming as the small increments proposed by Skinner (95). It may be that pupils in the upper grades are better able to learn from larger increments than those in the lower grades.

Another factor to consider is intelligence. In a recent study (79) it was found that questions inserted in films were as effective as class discussion during a break in the film and that the high intelligence group gained more than the low intelligence group. Ashbaugh (112) raises a serious doubt as to whether higher ability students actually spend less time in going through a small-step program as Skinner claims. If the above effect of intelligence could be proven, it might have a bearing on the most effective "size of step" for programmed materials. Hovland (21:642) in his review of whole-part learning makes the following generalization:

> . . . the best advice seems to be to learn by using the largest units that are meaningful and within the individual's capacity. The older the individual, the higher his intelligence, the more practice he has had, the greater is the size of unit he is able to handle.

2. It will be recalled that the adjusted mean scores almost always showed an increase from the treatment session to the delayed

knowledge of results testing session, but that the range between the adjusted mean scores decreased. This homogeneity of adjusted mean scores also held true for the retention testing session. This finding could have resulted from the students' discussion of the results between the treatment session and the delayed knowledge of results testing session and between the delayed knowledge of results and retention testing sessions; however, many questions can be raised about this phenomenon. What effect did delayed knowledge of results have on the outcome of the delayed knowledge of results and retention testing sessions? Were the non-significant differences in the retention testing session due to the delayed knowledge of results which was given in the delayed knowledge of results testing session? Did the repetition of the test filmstrip in the delayed knowledge of results testing session with its pictorial questions serve as a refresher, thus having an effect similar to the second showing of a film? (121) Did those receiving immediate knowledge of results during the presentation profit from the additional reinforcement of delayed knowledge of results given in the delayed knowledge of results testing session? Were knowledge of results on some items a factor in helping the students to answer other parts of the test correctly? These questions are all recommended for further study. Such studies could be designed to omit the delayed knowledge of results session or to modify the way in which it was handled. The item analysis technique could be employed and the effect of intermittent or continuous reinforcement with knowledge of results could be tried on larger units of content being taught over longer periods of time.

3. During the delayed knowledge of results phase, the writer noticed a good deal of tension; frustration was evident from the way the punchboards were treated. The source of this frustration may be related to different personality types, sex, intelligence, to the nature of the subject matter, or to the response made or device used in this study. Since these factors were not a part of this study and since the results of this study may have been influenced by these factors, further investigations are recommended to deal with these factors. A study by Ashbaugh (112), comparing overt and covert response modes, throws light on some of these factors. It was reported that greater variability existed among the overt response groups, and it was suggested that the overt responses may prove frustrating and annoying to certain personality types. The data also suggested that long continued use of overt responses may interfere with achievement and that low ability students, responding overtly, tend to spend less time on the program than do high ability students.

4. Heimer (119) found that the filmstrip form of programmed material for paced, group instruction was as successful as the same information put into programmed books and teaching machine formats for self-instructional purposes. Neither Heimer's study nor this present one was set up to experiment with the more elaborate forms and sophisticated methods of programmed material for group instruction. Recent developments by the teaching machine industry (103) make such studies feasible. These further studies could be designed for more adequate control of each individual's behavior and need not be limited to the filmstrip approach. If group applications of programmed

material can be found to be as successful as self-instructional approaches, then considerable administrative implications are forthcoming.

BIBLIOGRAPHY

A. Books

1. Barlow, John A. "The Earlham College Student Self-Instructional Project: a First Quarterly Report," Teaching Machines and Programmed Learning. (Edited by A A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 416-421.

2. Blyth, John W. "Teaching Machines and Human Beings," Teaching Machines and Programmed Learning. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 401-415.

3. Boehn, Charles H. Guide to the Use of Programmed Instruction. Harrisburg, Pennsylvania: Department of Public Instruction, 1961.

4. Briggs, L. J. and G. G. Besnard. "Experimental Procedures for Increasing Reinforced Practice in Training Air Force Mechanics for an Electrical System," Symposium on Air Force Human Engineering, Personnel, and Training Research. (Edited by G. Finch and F. Cameron.) Washington, D. C.: National Academy of Sciences - National Research Council, Publication 455, 1956. pp. 48-58.

5. Carr, W. J. "A Functional Analysis of Self-Instructional Devices," Teaching Machines and Programmed Learning. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 540-562.

6. Cook, J. O. and T. S. Kendler. "A Theoretical Model to Explain Some Paired-Associate Learning Data," Symposium on Air Force Human Engineering, Personnel, and Training Research. (Edited by G. Finch and F. Cameron.) Washington, D. C.: National Academy of Sciences - National Research Council, Publication 455, 1956. pp. 90-98.

7. Coulson, J. E. and J. F. Silberman. "Results of an Initial Experiment in Automated Teaching." Teaching Machines and Programmed Learning. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 452-468.

8. Cronbach, Lee J. Educational Psychology. New York: Harcourt, Brace and Company, 1954.

9. ________. _Educational Psychology_. Second edition. New York: Harcourt, Brace and World, Inc., 1963.

10. Deese, James. _The Psychology of Learning_. Second edition. New York: McGraw-Hill Book Company, 1958.

11. Evans, J. L., Robert Glaser, and Lloyd E. Homme. "A Preliminary Investigation of Variation in the Properties of Verbal Learning Sequences of the 'Teaching Machine' Type," _Teaching Machines and Programmed Learning_. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 446-451.

12. Fry, Edward. _Teaching Machines and Programmed Instruction_. New York: McGraw-Hill Book Company, 1963.

13. Gage, N. L. (ed.). _Handbook of Research on Teaching_. Chicago: Rand McNally and Company, 1963.

14. Gagne, R. M. and R. C. Bolles. "A Review of Factors in Learning Efficiency," _Automatic Teaching: The State of the Art_. (Edited by E. H. Galanter.) New York: John Wiley and Sons, 1959. Chapter 2.

15. Glaser, Robert, Lloyd Homme, and J. L. Evans. "An Evaluation of Textbooks in Terms of Learning Principles," _Teaching Machines and Programmed Learning_. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 437-445.

16. Guilford, J. P. _Fundamental Statistics in Psychology and Education_. Third Edition. New York: McGraw-Hill Book Company, Inc., 1956. p. 455.

17. Harris, Chester W. (ed.). _Encyclopedia of Educational Research_. New York: The Macmillan Company, 1960.

18. Holland, James G. "Teaching Machines: An Application of Principles from the Laboratory," _Teaching Machines and Programmed Learning_. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 215-228.

19. Homme, Lloyd. "The Rationale of Teaching by Skinner's Machines," _Teaching Machines and Programmed Learning_. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D. C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 133-136.

20. Hovland, C. I., A. A. Lumsdaine, and F. D. Sheffield. _Experiments on Mass Communication_. Princeton, New Jersey: Princeton University Press, 1949. Chapter 9.

21. Hovland, C. I. "Human Learning and Retention," Handbook of Experimental Psychology. (Edited by S. S. Stephens.) New York: John Wiley and Sons, Inc., 1960. Chapter 17.

22. Kanner, Joseph H. and Richard L. Sulzer. "Overt and Covert Rehearsal of Fifty Per Cent Versus One Hundred Per Cent of the Material in Film Learning," Student Response in Programmed Instruction. (Edited by A. A. Lumsdaine.) Washington, D. C.: National Academy of Sciences - National Research Council, Publication 943, 1961. Chapter 28.

23. Kingsley, H. L. The Nature and Conditions of Learning. New York: Prentice-Hall, 1946.

24. Lumsdaine, A. A. "Partial and More Complete Automation of Teaching in Group and Individual Situations," Automatic Teaching: The State of the Art. (Edited by E. H. Galanter.) New York: John Wiley and Sons, 1959. Chapter 13.

25. _________. "The Development of Teaching Machines and Programmed Self-Instruction," New Teaching Aids for the American Classroom. Stanford University, California: The Institute for Communication Research, 1960. pp. 136-173.

26. Lumsdaine, A. A., and Robert Glaser (eds.). Teaching Machines and Programmed Learning: A Source Book. Washington, D. C.: Department of Audio-Visual Instruction, National Education Association, 1960.

27. Lumsdaine, A. A. "Some Issues Concerning Devices and Programs for Automated Learning," Teaching Machines and Programmed Learning. (Edited by A. A. Lumsdaine and Robert Glaser.) Washington, D.C.: Department of Audio-Visual Instruction, NEA, 1960. pp. 517-539.

28. _________. "Some Conclusions Concerning Student Response and a Science of Instruction," Student Response in Programmed Instruction. (Edited by A. A. Lumsdaine.) Washington, D.C.: National Academy of Sciences - National Research Council, Publication 943, 1961. Chapter 31.

29. _________. "Instruments and Media of Instruction," Handbook of Research on Teaching. (Edited by N. L. Gage.) Chicago: Rand McNally and Company, 1963. Chapter 12.

30. McGeoch, J. A. and A. L. Irion. The Psychology of Human Learning. Second edition. New York: Longmans, Green, and Company, 1952.

31. Maccoby, N. and F. D. Sheffield. "Theory and Experimental Research on the Teaching of Complex Sequential Procedures by Alternate Demonstration and Practice," *Symposium on Air Force Human Engineering, Personnel, and Training Research*. (Edited by G. Finch and F. Cameron.) Washington, D. C.: National Academy of Sciences - National Research Council, Publication 516, 1958. pp. 99-107.

32. Margolius, Garry J. and Fred D. Sheffield. "Optimum Methods of Combining Practice with Filmed Demonstrations in Teaching Complex Response Sequences: Serial Learning of a Mechanical-Assembly Task," *Student Response in Programmed Instruction*. (Edited by A. A. Lumsdaine.) Washington, D. C.: National Academy of Sciences - National Research Council, Publication 943, 1961. Chapter 3.

33. Miller, Neal E., *et al*. *Graphic Communication and the Crisis in Education*. Washington, D. C.: Department of Audio-Visual Instruction, National Education Association, 1957.

34. Row, Arnold, *et al*. *Automated Teaching Methods Using Linear Programs*. Los Angeles: Department of Engineering, University of California, 1960.

35. Stephens, S. S. (ed.). *Handbook of Experimental Psychology*. New York: John Wiley and Sons, Inc., 1960.

36. Torrie, James H. and Robert G. D. Steel. *Principles and Procedures of Statistics with Special Reference to the Biological Sciences*. New York: McGraw-Hill Book Company, Inc., 1960. p. 114.

37. Travers, Robert M. *Essentials of Learning: An Overview for Students of Education*. New York: The Macmillan Company, 1963.

38. Weiss, Walter, Nathan Maccoby, and Fred D. Sheffield. "Combining Practice with Demonstrations in Teaching Complex Sequences: Serial Learning of a Geometric-Construction Task," *Student Response in Programmed Instruction*. (Edited by A. A. Lumsdaine.) Washington, D. C.: National Academy of Sciences - National Research Council, Publication 943, 1961. Chapter 4.

39. Wert, James E., Charles O. Neidt, and J. Stanley Ahmann. *Statistical Methods in Educational and Psychological Research*. New York: Appleton - Century - Crofts, Inc., 1954. pp. 199-201.

40. Wolfle, Dael. "Training," *Handbook of Experimental Psychology*. (Edited by S. S. Stephens.) New York: John Wiley and Sons, Inc., 1951. Chapter 34.

41. Woodworth, Robert S. and Harold Schlosberg. *Experimental Psychology*. Revised edition. New York: Henry Holt and Company, 1960.

B. Periodicals

42. Allen, William H. "Audio-Visual Materials," *Review of Educational Research*, 26:125-156, April, 1956.

43. ______. "Research on Film Use: Student Participation," *Audio-Visual Communication Review*, 5:423-450, Spring, 1957.

44. ______. "Research on New Educational Media: Summary and Problems," *Audio-Visual Communication Review*, 7:83-96, Spring, 1959.

45. ______. "Title VII Research Abstracts." *Audio-Visual Communication Review*; Installment 1, July-August, 1961; 2, November-December, 1961; 3, January-February, 1962; 4, May-June, 1962; 5, November-December, 1962.

46. Angell, George W. and Maurice E. Troyer. "A New Self-Scoring Test Device for Improving Instruction," *School and Society*, 67:84-85, 1948.

47. Arps, G. F. "A Preliminary Report on Work with Knowledge Versus Work without Knowledge of Results," *Psychological Review*, 24:449-455, 1917.

48. ____. "Work without Knowledge of Results Versus Work with Knowledge of Results," *Psychological Monograph*, No. 125, 1920.

49. Auble, D. and E. Mech. "Response Strength in a Classroom Task Related to Forward Delay in Reinforcement," *Journal of Educational Psychology*, 45:175-181, 1954.

50. Carpenter, C. R. "Boundaries of Learning Theories and Mediators of Learning," *Audio-Visual Communication Review*, 10:295-306, November-December, 1962.

51. Coulson, John E. and Harry F. Silberman. "Automated Teaching and Individual Differences," *Audio-Visual Communication Review*, 9:5-15, 1961.

52. Cook, Desmond L. "Programmed Instruction and AV Personnel in the Future," *Audio-Visual Communication Review*, 10:238-249, July-August, 1962.

53. Cook, J. O. "Supplementary Report: Processes Underlying Learning a Single Paired-Associate Item." *Journal of Experimental Psychology*, 56:455, November, 1958.

54. Cook, J. O. and M. E. Spitzer. "Supplementary Report: Prompting Versus Confirmation in Paired Associate Learning," Journal of Experimental Psychology, 59:275-276, 1960.

55. Cook, T. W. "Factors in Whole and Part Learning a Visually Perceived Maze," Journal of Genetic Psychology, 49:3-31, 1936.

56. ____. "Whole Versus Part Learning the Spider Maze," Journal of Experimental Psychology, 20:477-494, 1937.

57. Curtis, F. D. and G. G. Woods. "A Study of the Relative Teaching Values of Four Common Practices in Correcting Examination Papers," School Review, 37:615-623, October, 1929.

58. Dearborn, W. F. "Experiment in Learning," Journal of Educational Psychology, 1:375, 1910.

59. Deese, James. "Comment and Summary: A Mine of Possible Applications," Audio-Visual Communication Review, 9:86, September-October, 1961.

60. Feldhusen, John and Andrew Birt. "A Study of Nine Methods of Presentation of Programed Learning Materials," The Journal of Educational Research, 55:461-466, June-July, 1962.

61. Ferster, Charles B. and Stanley M. Sapon. "An Application of Recent Developments in Psychology to the Teaching of German," Harvard Educational Review, 28:58-69, Winter, 1958.

62. Freeman, James T. "The Effects of Reinforced Practice on Conventional Multiple-Choice Tests," Automated Teaching Bulletin, 1:19-20, September, 1959.

63. Gavurin, E. I. and V. M. Donahue. "Logical Sequence and Random Sequence," Automated Teaching Bulletin, 1:3-9, Spring, 1961.

64. Geis, George L. "Some Considerations in the Evaluation of Programs," Audio-Visual Communication Review, 10:64-69, January-February, 1962.

65. Glaser, Robert. "Learning and the Technology of Instruction," Audio-Visual Communication Review, 9:42-55, September-October, 1961.

66. Hall, W. J. "A Study of Three Methods of Teaching Science with Classroom Films," School Science and Mathematics, 36:968-970, 1936.

67. Hanawalt, E. M. "Whole and Part Methods in Trial and Error Learning," Comparative Psychol Monograph, 7, 1931.

68. Hough, John B. and Bernard Revsin. "Programed Instruction at the College Level: A Study of Several Factors Influencing Learning," Phi Delta Kappan, 44:286-291, March, 1963.

69. Kantor, Bernard R. "Effectiveness of Inserted Questions in Instructional Films," Audio-Visual Communication Review, 8:104-108, 1960.

70. Keislar, Evan. "The Development of Understanding in Arithmetic by a Teaching Machine," Journal of Educational Psychology, 50:247-253, December, 1959.

71. Lakeman, M. E. "The Whole and Part Methods of Memorizing Poetry and Prose," Journal of Educational Psychology, 4:189-198, 1913.

72. Levine, Seymour, "The Role of Motivation in the Effects of 'Active Review' on Learning from a Factual Film," The American Psychologist, 8:388-389, August, 1953.(abstract)

73. Little, J. K. "Results of Use of Machines for Testing and for Drill upon Learning in Educational Psychology," Journal of Experimental Education, 3:45-49, September, 1934.

74. Lumsdaine, A. A. "Some Critical Issues in the Improvement of Instruction Through Programed Learning," Audio-Visual Communication Review, 10:61-64, January-February, 1962.

75. McGeoch, G. O. "The Intelligence Quotient as a Factor in the Whole-Part Problem," Journal of Experimental Psychology, 14:333-358, 1931.

76. Mager, Robert F. "On the Sequencing of Instructional Content," Psychological Reports, 9:405-413, 1961.

77. May, Mark A. "The Psychology of Learning from Demonstration Films," Journal of Educational Psychology, 37:1-12, January, 1946.

78. Michael, Donald N. and Nathan Maccoby. "Factors Influencing Verbal Learning from Films under Varying Conditions of Audience Participation," Journal of Experimental Psychology, 46:411-418, 1953.

79. Minter, Philip C., Fritz A. Albert, and Richard D. Powers. "Does Presentation Method Influence Film Learning?" Audio-Visual Communication Review, 9:195-200, July-August, 1961.

80. Moldstad, John. "Doctoral Dissertations in A-V Education," Audio-Visual Communication Review, 4:291-333, Fall, 1956; 6:33-48, Winter, 1958; 7:142-153, Spring, 1959; 9:220-229, July-August, 1961.

81. Moore, J. William and Wendell I. Smith. "Knowledge of Results in Self-Teaching Spelling," *Psychological Reports*, 9:717-726, December, 1961.

82. Pechstein, L. A. "Whole Versus Part Methods in Motor Learning. A Comparative Study." *Psychological Monographs*, 23, 1917.

83. ________. "The Whole Versus Part Methods in Learning: Comparison and Summary," *Stud Education*, 15:181-186, 1926.

84. Peterson, J. C. "A New Device for Teaching, Testing, and Research in Learning," *Transactions of the Kansas Academy of Science*, 33:41-47, 1930.

85. Porter, D. "A Critical Review of a Portion of the Literature on Teaching Devices," *Harvard Educational Review*, 27:126-147, Spring, 1957.

86. ______. "Teaching Machines," *Harvard Graduate School of Education Bulletin*, 3:1-5, March, 1958.

87. Postman, Leo. "Human Learning and Audio-Visual Education," *Audio-Visual Communication Review*, 9:68-78, September-October, 1961.

88. Pressey, Sidney L. "A Simple Apparatus Which Gives Tests and Scores -- and Teaches," *School and Society*, 23:373-376, 1926.

89. _______. "Development and Appraisal of Devices Providing Immediate Automatic Scoring of Objective Tests and Concomitant Self-Instruction," *Journal of Psychology*, 29:417-447, April, 1950.

90. _______. "Pressey Writes on 'Auto-Instruction'," *Phi Delta Kappan*, 44:396, May, 1963.

91. Ruban-Rabson, G. "Studies in the Psychology of Memorizing Piano Music: III. A Comparison of the Whole and the Part Approach," *Journal of Educational Psychology*, 31:460-476, 1940.

92. Saltzman, I. J. "Delay of Reward and Human Verbal Learning," *Journal of Experimental Psychology*, 41:437-439, June, 1951.

93. Silberman, Harry F. "Self-Teaching Devices and Programmed Materials," *Review of Educational Research*, 32:179-193, April, 1962.

94. Skinner, B. F. "The Science of Learning and the Art of Teaching," *Harvard Educational Review*, 24:86-97, Spring, 1954.

95. ______. "Teaching Machines," *Science*, 128:969-977, October 24, 1958.

96. Spence, Kenneth W. "The Relation of Learning Theory to the Technology of Education," *Harvard Educational Review*, 29:84-95, Spring, 1959.

97. Steffens, L. "Experimentille Beiträge Zur Lehre Vom Ökonomischen Lernen," *Z. Psychol*, 22:321-382, 1900.

98. Thorndike, E. L. "The Law of Effect," *American Journal of Psychology*, 39:212-222, 1927.

99. Trowbridge, M. H. and H. Cason. "An Experimental Study of Thorndike's Theory of Learning," *Journal of General Psychology*, 7:245-258, 1932.

100. VanderMeer, A. W. "Our Debt to Educational Philosophy," *Audio-Visual Communication Review*, 8:46, 1960.

101. Yale University Motion Picture Research Project. "Do 'Motivation' and 'Participation' Questions Increase Learning?" *Educational Screen*, 26:256-259, 274, 283, May, 1947.

C. Publications of the Government

102. Bryan, G. L. and J. W. Rigney. *An Evaluation of a Method for Shipboard Training in Operations Knowledge*. Technical Report No. 18; prepared for the Personnel and Training Branch, Psychological Sciences Division, Office of Naval Research, at the Department of Psychology, University of Southern California, Los Angeles, April, 1957.

103. Finn, James D. and Donald G. Perrin. *Teaching Machines and Programed Learning, a Survey of the Industry, 1962*. Washington, D. C.: U. S. Government Printing Office, June, 1962.

104. Gibson, J. J. (ed.). *Motion Picture Testing and Research*. Army Air Forces Report, No. 7. Washington, D. C.: Superintendent of Documents, Government Printing Office, 1947, p. 148.

105. Harby, S. F. *Evaluation of a Procedure for Using Daylight Projection of Film Loops in Teaching Skills*. Port Washington, New York: Special Devices Center, Office of Naval Research, June, 1952. Technical Report SDC 269-7-27.

106. Hirsch, R. S. *The Effects of Knowledge of Test Results on Learning of Meaningful Material*. (The Pennsylvania State University) Port Washington, New York: Special Devices Center, Office of Naval Research, September, 1952. Technical Report SDC 269-7-30.

107. Irion, A. L. and L. J. Briggs. *Learning Task and Mode of Operation Variables in Use of the Subject Matter Trainer*. Lowry Air Force Base, Colorado: Air Force Personnel and Training Research Center, October, 1957. Technical Report AFPTRC-TR-57-8 (ASTIA Document No. AD 134252).

108. Kurtz, A. K., J. S. Walter, and H. R. Brenner. *The Effects of Inserted Questions and Statements on Film Learning (Rapid Mass Learning)*. Port Washington, New York: Special Devices Center, Office of Naval Research, September, 1950. Technical Report SDC 269-7-16.

109. Michael, D. N. *Some Factors Influencing the Effects of Audience Participation on Learning from a Factual Film*. Memorandum Report, Human Resources Research Laboratory, Headquarters Command, Bolling Air Force Base, Washington, D. C., December, 1951. HRRL-MR-13A.

110. Stein, J. J. *The Effect of a Pre-Film Test on Learning from an Educational Sound Motion Picture*. (The Pennsylvania State University) Port Washington, New York: Special Devices Center, Office of Naval Research, November, 1952. Technical Report SDC 269-7-35.

111. Zuckerman, Carl B., George R. Marshal, and Sanford Groesberg. *Research in the Automation of Teaching*. Technical Report NAVTRA DEUCEN 661-1 Prepared by the Department of Psychology, Brooklyn College. Port Washington, New York: U. S. Naval Training Device Center, February 16, 1961.

D. Unpublished Materials

112. Ashbaugh, William H. "The Effect upon Achievement of Written Responses to Programmed Learning Material for Students of Differing Academic Ability." Unpublished Doctor's Thesis, The Pennsylvania State University, 1962.

113. Briggs, Leslie J. "The Development and Appraisal of Special Procedures for Superior Students and an Analysis of the Effects of 'Knowledge of Results'." *Abstracts of Doctoral Dissertations*, 58, 1949. (Columbus: The Ohio State University Press.)

114. Campbell, Vincent. "Adjusting Self-Instruction Programs to Individual Differences: Studies of Cueing, Responding, and Bypassing." American Institute for Research, July, 1961 (USOE Grant No. 736103).

115. Craig, Richard. "Analysis of Covariance." The Computation Center, The Pennsylvania State University, April, 1963.

116. Cropper, George L. and A. A. Lumsdaine. "An Experimental Comparison of a Conventional TV Lesson with a Programmed TV Lesson Requiring Active Student Response." Studies in Televised Instruction, Report No. 2. Pittsburgh: Metropolitan Pittsburgh Educational Television Stations, WQED-WQEX and American Institute for Research, March, 1961. (USOE Project No. 336).

117. _______. "An Experimental Evaluation of the Contributions of Sequencing, Pre-testing, and Active Student Responses to the Effectiveness of 'Programmed' TV Instruction." Studies in Televised Instruction, Report No. 3. Pittsburgh: Metropolitan Pittsburgh Educational Television Stations, WQED-WQEX and American Institute for Research, April, 1961. (USOE Project No. 336).

118. Edwards, W. D. "Skinner's Teaching Machines." Unpublished Laboratory Note, Maintenance Laboratory, AFPTRC, Lowry Air Force Base, Colorado, May, 1956. (mimeographed)

119. Heimer, Ralph T. "The Preparation of a Program in Contemporary Algebra and a Study of Its Effectiveness for Group Instruction under Paced Conditions." Unpublished Doctor's thesis, The Pennsylvania State University, 1962.

120. Kurpiewski, Boleslaus S. "The Effectiveness of a Modified Classroom Communicator in the Study of Learning and Retention." Unpublished Doctor's thesis, The University of Oklahoma, 1958.

121. MacTavish, Chester L. "Effect of Repetitive Film Presentations on Learning." Unpublished Doctor's thesis, The Pennsylvania State University, 1953.

122. Meyer, Susan R. "A Test of the Principles of 'Activity', 'Immediate Reinforcement', and 'Guidance' as Instrumented by Skinner's Teaching Machine." Unpublished Doctor's thesis, The University of Buffalo, 1960. (Dissertation abstracts, 20:4729-4730, April-June, 1960).

123. Orbison, W. D. "The Relative Efficiency of Whole and Part Methods of Learning Paired-Associates as a Function of the Length of List." Unpublished Doctor's thesis, Yale University, 1944.

124. Severin, D. G. "Appraisal of Special Tests and Procedures Used with Self-Scoring Instructional Testing Devices." _Abstracts of Doctoral Dissertations_, 66:323-330, 1955. (Columbus: The Ohio State University Press.)

125. Smith, Wendell and J. William Moore. "Size-of-Step and Achievement in Programed Spelling." Lewisburg, Pennsylvania: Bucknell University, September, 1961. (USOE Project No. 485).

126. "The Rapid-Rater, an Educational Tool from Shaw Laboratories, Inc." 21 Harriet Drive, Syosset, L. I., New York.

127. VanderMeer, A. W. "An Investigation of the Improvement of Informational Filmstrips and the Derivation of Principles Relating to the Effectiveness of these Media." National Defense Education Act, Title VII, Grant No. 7-36-049.00. The Pennsylvania State University, 1961.

128. __________. "Research in Audio-Visual Media." A brief paper read at the American Educational Research Association, Atlantic City, New Jersey, February 19, 1962.

129. __________. "An Investigation of Principles of Programming and Size of Learning Steps as Applied to the Production and Utilization of Filmstrips and Filmstrip-Type Materials in Natural Science." National Defense Education Act, Title VII, Grant No. 7-36-123.01. The Pennsylvania State University, 1963.

E. Newspapers

130. Anderson, M. T. "'Local Option', Plan to Spur School Attendance Not Used in Greenville," _Greenville_ [South Carolina] _News_, October 11, 1962.

APPENDIX A

Tables 54 to 57

TABLE 54

FILMSTRIP PRESENTATION SCHEDULE FOR METHODS GROUPS AND RESULTS GROUPS

School and Grade Level	Method	Groups*	Group Scheduled First
Elementary: Grade 5-6			
Donaldson	Sequence	1-2	I know+ (1)
Augusta Circle	Frame	3-4	I know (3)
Serrine	Whole	17-18	No know++ (17)
Jr. High: Grade 7-8			
Hughes	Sequence	11-12	No know (11)
Hughes	Whole	13-14	I know (13)
Hughes	Frame	15-16	No know (15)
Sr. High: Grade 11			
Greenville	Whole	5-6	No know (5)
Greenville	Sequence	7-8	I know (7)
Greenville	Frame	9-10	No know (9)

* The groups (experimental and control) are numbered according to the order in which they were subjected to the filmstrip presentation.

+ I know means Immediate knowledge of results (Experimental group).

++ No know means No knowledge of results (Control group).

TABLE 55

FRAME METHOD: THE NUMBERS OF THE INFORMATION-FRAMES AND ACCOMPANYING QUESTION-FRAMES

Frame Number	Question Number(s)
1	1-3
2	4-10
3	11-12
4	13
5	14
6	15-20
7	21-22
8	23
9	24-25
10	26-27
11	28-30
12	31
13	32-33
14	34
15	35-37
16	38-39
17	40-41
18	42-44
19	45-48
20	49-52
21	53-55
22	56-59
23	60-61
24	62-64
25	65-66
26	67
27	68
28	69
29	70
30	71
31	72-73
32	74
33	75-78
34	79-80

TABLE 56

SEQUENCE METHOD: THE SEQUENCE NUMBER ACCOMPANIED BY THE NUMBERS OF THE INFORMATION-FRAMES AND QUESTION-FRAMES FOR THAT SEQUENCE

Sequence Number	Frame Number(s)	Question Number(s)
1	1,2	1-10
2	3,4,5	11-14
3	6,7	15-22
4	8,9,10	23-27
5	11,12,13,14	28-34
6	15,16,17	35-41
7	18,19,20,21,22	42-59
8	23,24,25	60-66
9	26	67
10	27,28	68-69
11	29,30,31,32,33,34	70-80

TABLE 57

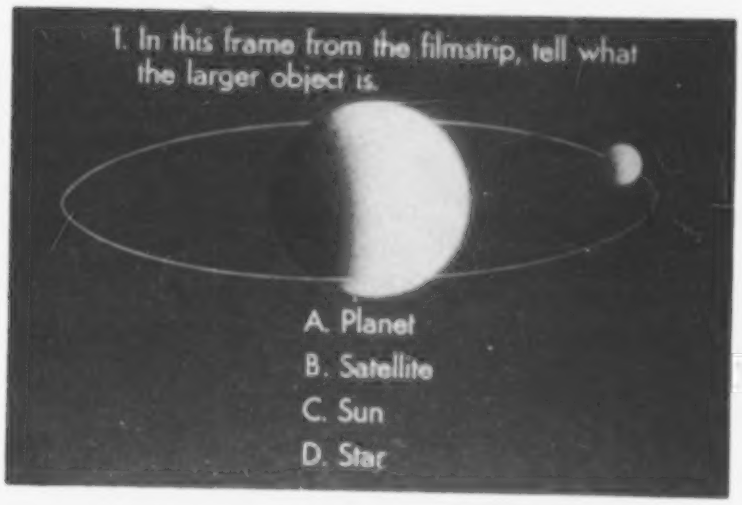
A SUMMARY OF THE NUMBER OF INFORMATION-FRAMES AND QUESTION-FRAMES PER SEQUENCE

	Sequence Number	Information Frame(s) per Sequence	Question Frame(s) per Sequence
	1	2	10
	2	3	4
	3	2	8
	4	3	5
	5	4	7
	6	3	7
	7	5	18
	8	3	7
	9	1	1
	10	2	2
	11	6	11
Total	11	34	80

APPENDIX B

Criterion Measure

EARTH'S SATELLITE -- THE MOON



1. In this frame from the filmstrip, tell what the larger object is.

A. Planet
B. Satellite
C. Sun
D. Star

2. A satellite can be best described by the term

A. planet
B. moon
C. star
D. sun

3. Satellites follow what direction around a planet?

A Same direction as the hands of a clock
B. Always upward toward the sun
C. Opposite the direction of the hands of a clock
D. Always downward away from the sun

4. The planet with the greatest number of satellites is which of the following?

A. Pluto
B. Jupiter
C. Venus
D. Earth

5. Which planet appeared to be the smallest in size?

A. Uranus
B. Neptune
C. Jupiter
D. Mercury

6. A planet shown with rings around it is named

   A. Saturn
   B. Jupiter
   C. Earth
   D. Neptune

7. Pluto's satellites would number

   A. 2
   B. 4
   C. unknown
   D. 9

8. Give the number of Jupiter's satellites.

   A. 5
   B. 12
   C. 1
   D. 9

9. The number of known satellites is

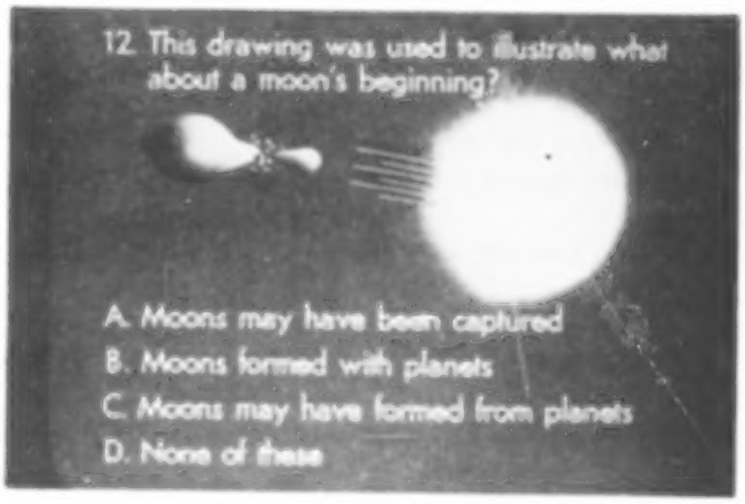
   A. 39
   B. 31
   C. 15
   D. 9

10. Select the following planet that has no moon.

    A. Mercury
    B. Uranus
    C. Saturn
    D. Mars

11. Which statement from the filmstrip best tells how moons came to be?

    A. No one knows
    B. They have always existed
    C. They are dead stars
    D. They just happened



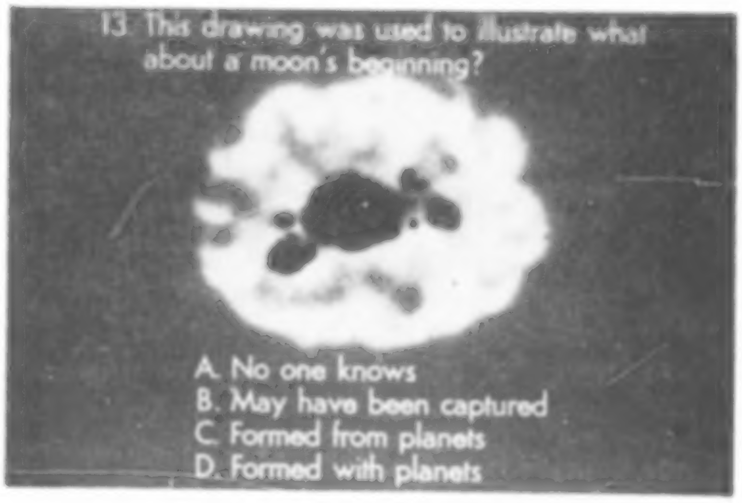
12. This drawing was used to illustrate what about a moon's beginning?

A. Moons may have been captured

B. Moons formed with planets

C. Moons may have formed from planets

D. None of these



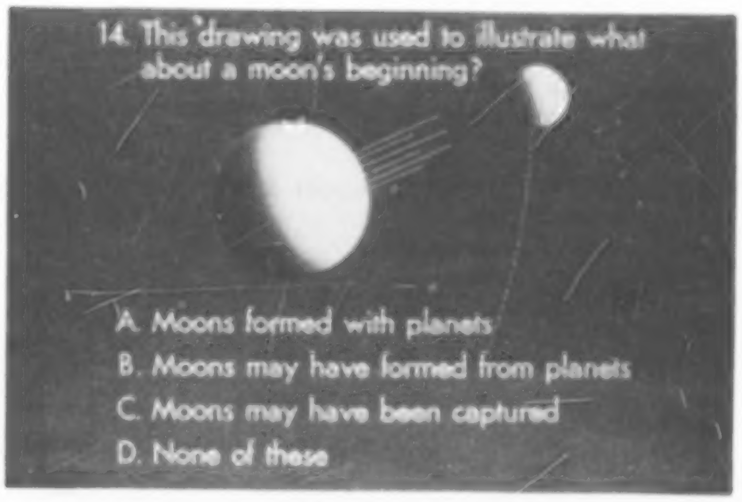
13. This drawing was used to illustrate what about a moon's beginning?

A. No one knows

B. May have been captured

C. Formed from planets

D. Formed with planets



14. This drawing was used to illustrate what about a moon's beginning?

A. Moons formed with planets

B. Moons may have formed from planets

C. Moons may have been captured

D. None of these

15. The closest the moon comes to the earth is

    A. 93,000,000 miles
    B. 222,000 miles
    C. 253,000 miles
    D. 2,380 miles

16. Which of the following is the earth's nearest neighbor?

    A. Sun
    B. Mars
    C. Mercury
    D. Moon

17. The diameter of the moon compared with the earth is

    A. two times larger
    B. four times larger
    C. one-half as large
    D. one-fourth as large

18. The average distance the moon is from earth is

    A. 238,000 miles
    B. 220,000 miles
    C. 253,000 miles
    D. 238,000,000 miles

19. Which is the closest to the diameter of the moon?

    A. 238,000 miles
    B. 222,000 miles
    C. 8,000 miles
    D. 2,380 miles

20. What is the greatest distance that the moon is from earth?

    A. 93,000,000 miles
    B. 1,000,000 miles
    C. 253,000 miles
    D. 220,000 miles

21. What is the point where the moon is nearest the earth called?

    A. Apogee
    B. Zenith
    C. Elliptic
    D. Perigee

22. The apogee of the moon's path around the earth is the

A. place the moon appears in the western sky
B. most distant point from earth
C. closest point to earth
D. average distance from earth

23. Why do the sun and moon seem to be the same size to us on earth?

A. The sun is 400 times larger and 400 times closer
B. The sun is 400 times larger and is 400 times farther away
C. The moon is 400 times larger and is 400 times farther away
D. The moon is 400 times larger and 400 times closer

24. The moon shines mainly because

A. it reflects sunlight
B. it is on fire
C. it is made of luminous matter
D. it has radium in its composition

25. Sometimes the darker part of the moon can be seen by

A. light reflected from Saturn
B. light reflected from Earth
C. light reflected from Jupiter
D. light reflected from Uranus

26. The apparent size of the moon on the horizon is explained by

A. optical illusion
B. farsightedness
C. nearsightedness
D. optical defects

27. When it is rising or setting, the moon seems

A. the same size as when it is high in the sky
B. sometimes larger and sometimes smaller than when it is high in the sky
C. larger than when it is high in the sky
D. smaller than when it is high in the sky

28. The length of time that the moon is waxing is about

A. two weeks
B. two months
C. two hours
D. two days

29. The term waxing moon means that it

    A. is in the last weeks of its orbit
    B. is invisible because of clouds
    C. is becoming hotter each night
    D. is becoming more full each night

30. Which would look the most like the full moon?

    A. Crescent moon
    B. Half moon
    C. New moon
    D. Gibbous moon

31. At the same hour each night the waxing moon appears

    A. in the same position in the sky
    B. in a different position in the sky
    C. larger in the same position in the sky
    D. a different color in the same position in the sky

32. The waning moon phases take place during what period of time?

    A. First two months of its orbit
    B. Second two months of its orbit
    C. Second two weeks of its orbit
    D. First two weeks of its orbit

33. The term that describes the moon's lighted part becoming less full is which of the following?

    A. Waning
    B. Crescent
    C. Waxing
    D. Gibbous

34. A waning moon is seen

    A. at noon and in the early afternoon
    B. immediately after sunset only
    C. after sunrise
    D. late at night and in the early morning hours

35. The moon is a globe revolving around the earth about how often?

    A. Once every day
    B. Once every year
    C. Once every century
    D. Once every month

36. Which statement describes the sunlight falling on the moon?

    A. The sunlight strikes nearly the whole surface at once
    B. The sunlight strikes three-fourths of the surface at once
    C. The sunlight strikes about one-half of the surface at once
    D. The sunlight strikes one-fourth of the surface at once

37. The phase of the moon changes about once every

    A. day
    B. 2 days
    C. 3 1/2 days
    D. week

38. Which statement best shows the relationship between the moon's revolution and its rotation?

    A. It rotates once during each two revolutions
    B. It rotates three times during each revolution
    C. It rotates once during each revolution
    D. It rotates four times during each revolution

39. Why do we see only one side of the moon?

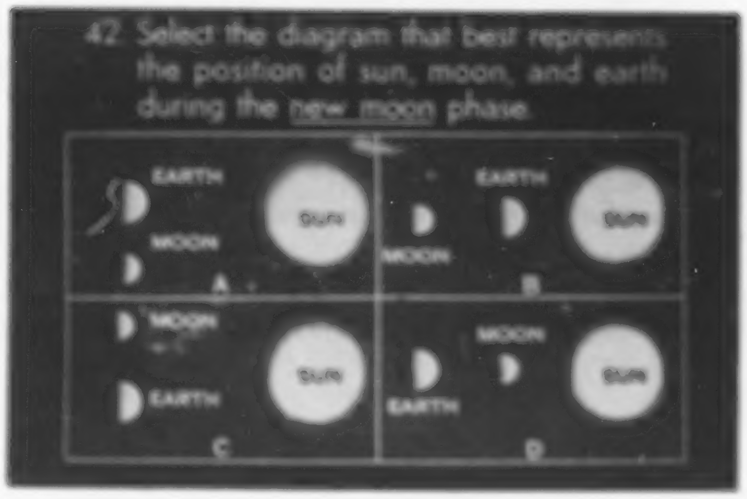
    A. Because it rotates once during each revolution
    B. Because it rotates any number of times during each revolution
    C. Because it rotates twice during each revolution
    D. Because it rotates three times during each revolution

40. The cause for the changes in the amount of the moon's surface that is visible from the earth is

    A. the rotation of the moon
    B. the revolution of the moon
    C. the revolution of the earth
    D. the rotation of the earth

41. How many phases does the moon go through when it makes one revolution?

    A. Four
    B. Six
    C. Two
    D. Eight



42. Select the diagram that best represents the position of sun, moon, and earth during the new moon phase.

EARTH
SUN
MOON
A
EARTH
SUN
MOON
B
MOON
SUN
EARTH
C
MOON
SUN
EARTH
D

43. The new moon as seen from earth

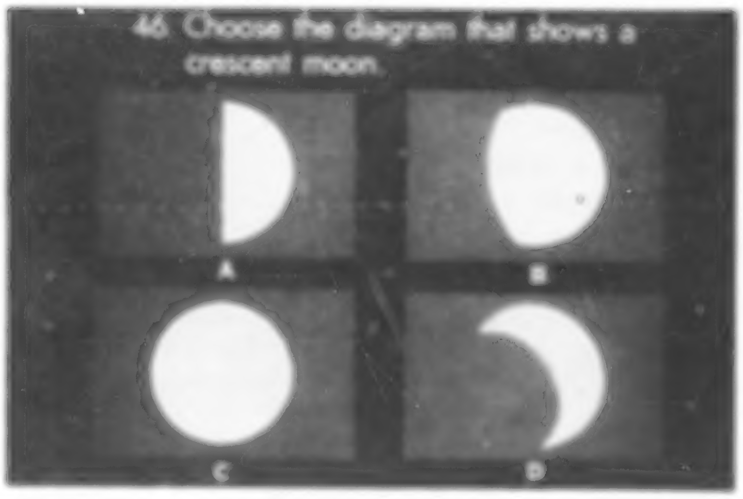
    A. is invisible in the sunlight
    B. is nearly as bright as the sun
    C. is much larger than the other phases
    D. always has a halo around it

44. The phase of the moon when it is directly between the earth and sun is which of the following?

    A. New moon
    B. Crescent moon
    C. Gibbous moon
    D. Full moon

45. What is the very next phase that follows a new moon?

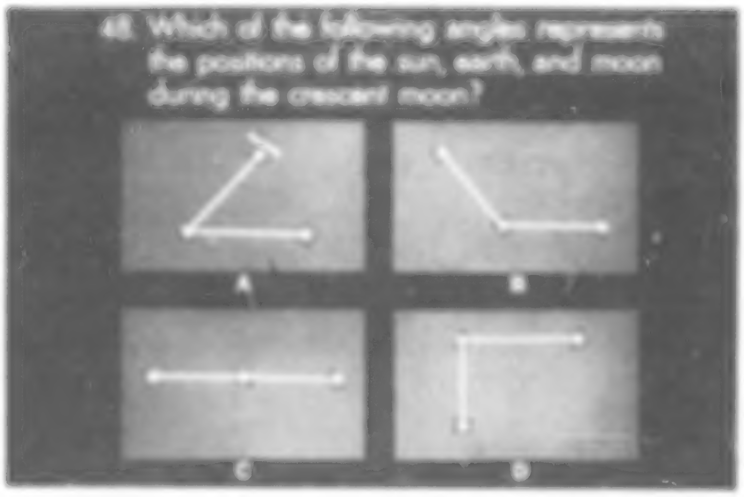
    A. Crescent moon
    B. Gibbous moon
    C. Full moon
    D. Half moon



46. Choose the diagram that shows a crescent moon.

47. About how long does it take the moon to go from new moon to crescent moon?

A. 10 days
B. 1 week
C. 3 1/2 days
D. 5 days



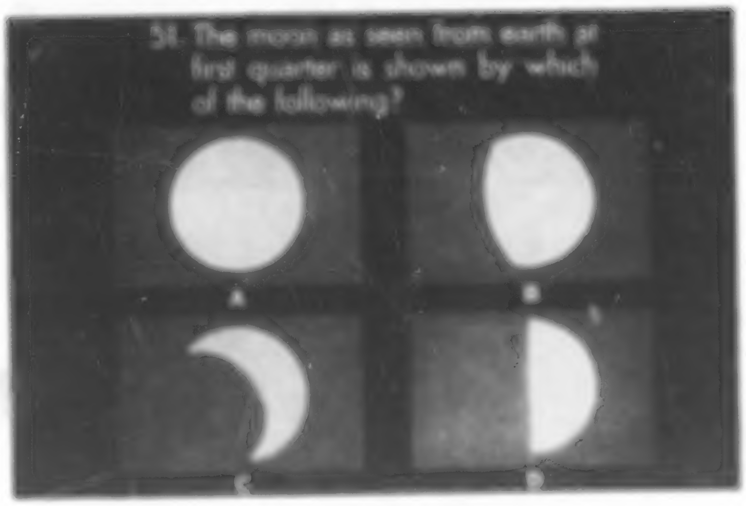
48. Which of the following angles represents the positions of the sun, earth, and moon during the crescent moon?

49. The time the moon takes to reach first quarter from new moon is about

A. one fortnight
B. one day
C. one month
D. one week

50. If the moon is new on October 1, what phase would occur on October 8?

- A. Crescent moon
- B. Half moon
- C. Gibbous moon
- D. Full moon



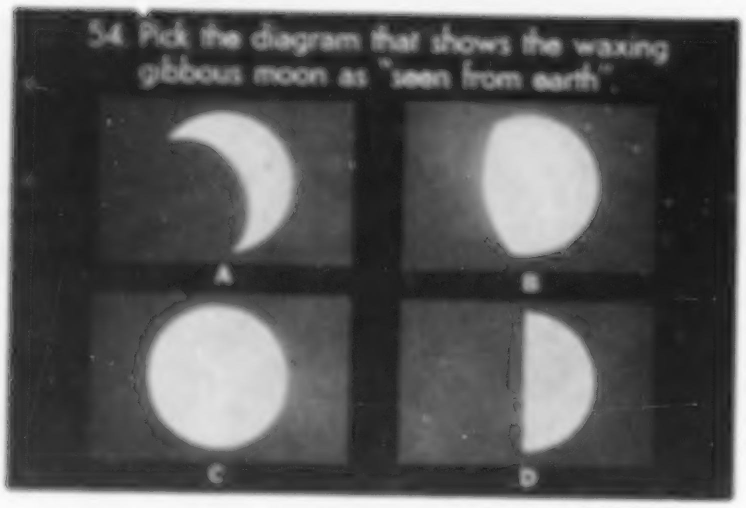
51. The moon as seen from earth at first quarter is shown by which of the following?

52. How much of the lighted side of the moon do we see at first quarter?

- A. One-eighth
- B. Three-fourths
- C. One-fourth
- D. One-half

53. During the gibbous moon phase the amount of the lighted side facing the earth is about how much?

- A. One-fourth
- B. Three-fourths
- C. One-half
- D. One-eighth



54. Pick the diagram that shows the waxing gibbous moon as "seen from earth".

55. Seeing the waxing gibbous moon rising is difficult because it

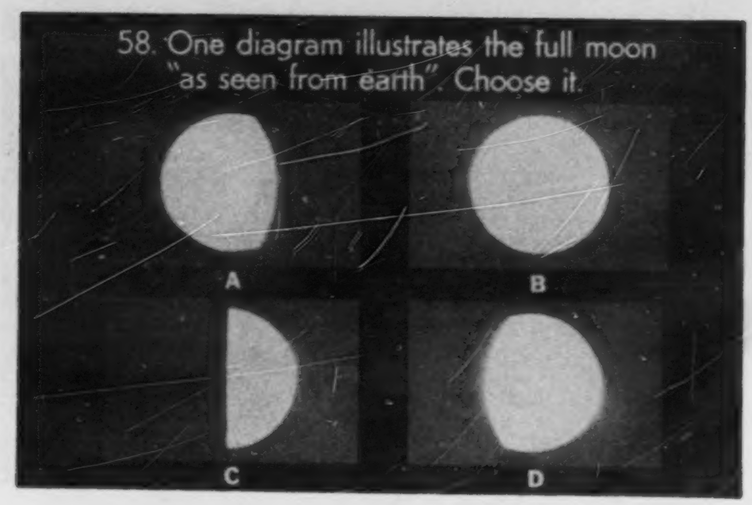
A. rises in the afternoon
B. rises at midnight
C. rises at sunrise
D. rises in the morning

56. What is the position of the sun, earth, and moon during the full moon phase?

A. The moon is between the earth and sun
B. The sun is between the earth and moon
C. The earth is between the sun and moon
D. The moon, sun, and earth form a right angle

57. When the moon is full, it has traveled how far around the earth since the new moon?

A. Three-fourths of the way
B. All of the way
C. One-fourth of the way
D. Half of the way



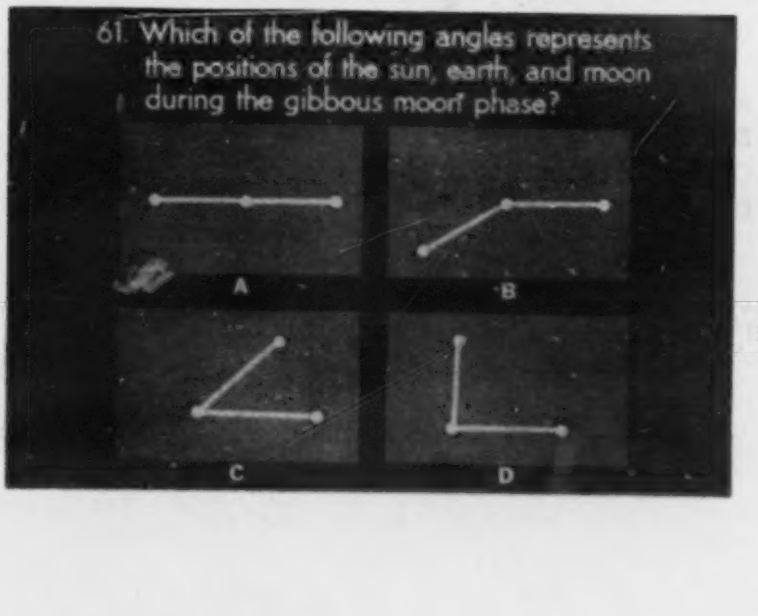
58. One diagram illustrates the full moon "as seen from earth". Choose it.

59. During the full moon phase the moon rises at what time?

   A. Sunset
   B. Midnight
   C. Noon
   D. Sunrise

60. After the full moon phase, which way does the flatter side of the gibbous moon face?

   A. Toward the sun
   B. Away from the sun
   C. At right angles to the sun
   D. Slanting toward the sun



61. Which of the following angles represents the positions of the sun, earth, and moon during the gibbous moon phase?

62. It takes the moon about how many days to go 3/4 of the way around the earth?

    A. 22
    B. 26
    C. 28
    D. 30

63. During the third quarter the moon rises about what time?

    A. Sunrise
    B. Sunset
    C. Midnight
    D. Noon

64. The phase of the moon when it is 3/4 of the way around the earth from new moon is

    A. full moon
    B. half moon
    C. crescent moon
    D. gibbous moon

65. As the moon nearly completes its cycle, the amount of light facing the earth is how much?

    A. A thin crescent
    B. One-fourth of the surface
    C. One-half of the surface
    D. Three-fourths of the surface

66. What is the shape of the visible part of the moon when it rises just before sunrise?

    A. Half moon
    B. A thin crescent
    C. Gibbous moon
    D. Full moon

67. The Indian "month" measured what period of time?

    A. From full moon to full moon
    B. From new moon to full moon
    C. From new moon to crescent moon
    D. From full moon to new moon

68. What can we see on the moon with our bare eyes or binoculars?

    A. Light and dark patches
    B. Forests and deserts
    C. Smooth places and rough places
    D. Lakes and oceans

69. The dark patches on the moon are really what?

- A. Lowlands
- B. Highlands
- C. Mountains
- D. Craters

70. The astronomical telescope shows objects to appear how?

- A. Distorted
- B. As the eye sees them
- C. Reversed
- D. Up-side-down

71. The terminator in a photo of the crescent moon through a telescopy is really what?

- A. The moon's atmosphere
- B. The boundary between light and dark sides
- C. The mountainous rough parts
- D. The dark portion of the moon

72. The mountains and craters on the moon are seen in fine detail through a telescope under what conditions?

- A. When the moon is full or new
- B. When the moon is gibbous or crescent
- C. Only when the moon is new
- D. Only when the moon is full

73. Why does not the terminator in a telephotograph appear to be a smooth line on the moon?

- A. Because no telescope is perfect
- B. Because of forests and other growths
- C. Because of mountain and crater shadows
- D. Because of an optical illusion

74. During a full moon which of the following is true?

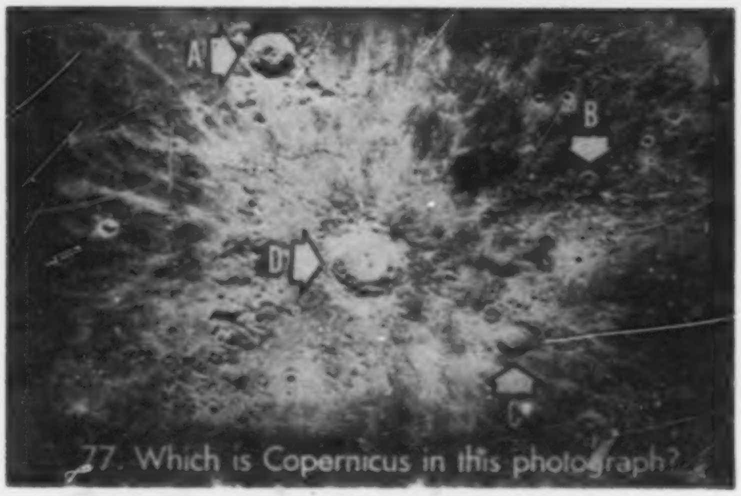
- A. There are some shadows on the moon
- B. The sun shines directly down on the moon
- C. There is not much reflection of light
- D. Fine details do not disappear

75. What is the number of craters scientists believe exist on the moon?

- A. 56
- B. 12,000
- C. 30,000
- D. 138,000

76. What is the distance across Copernicus?

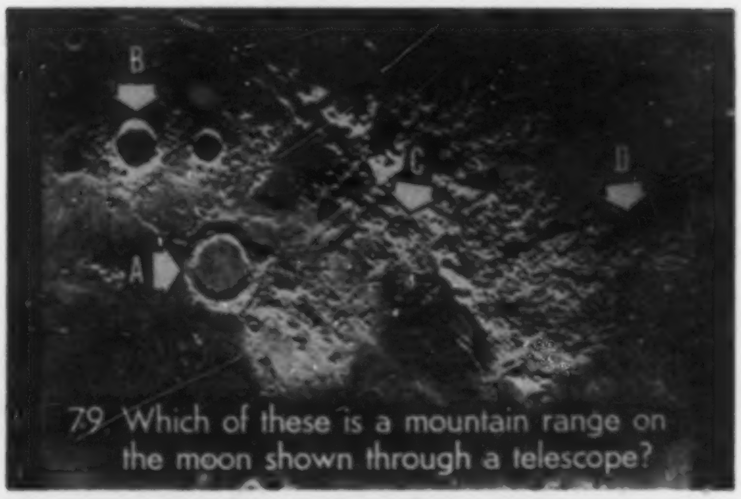
A. 56 feet
B. 56 miles
C. 12,000 feet
D. 30,000 feet



77. Which is Copernicus in this photograph?

78. Copernicus is the name of which of the following on the moon?

A. A crater
B. A mountain range
C. A sea
D. A plain



79. Which of these is a mountain range on the moon shown through a telescope?

80. Which of the following is a mountain range on the moon?

- A. None of these
- B. Appalachian
- C. Copernicans
- D. Apennines

APPENDIX C

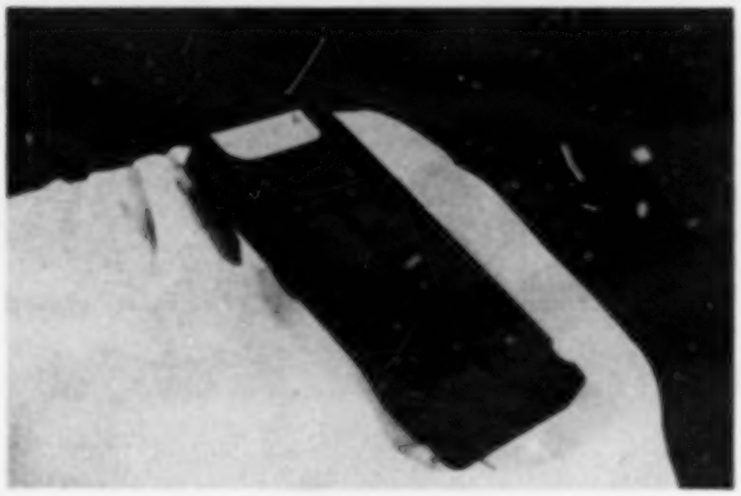
35 mm Slide Series on the Use of the Punchboard Device

35 mm SLIDE SERIES ON THE USE OF THE PUNCHBOARD DEVICE

I am going to give each one of you a device called a punchboard. We will be using this devide as a part of our research project. Please hold your punchboard and do nothing with it until you are given further instructions.

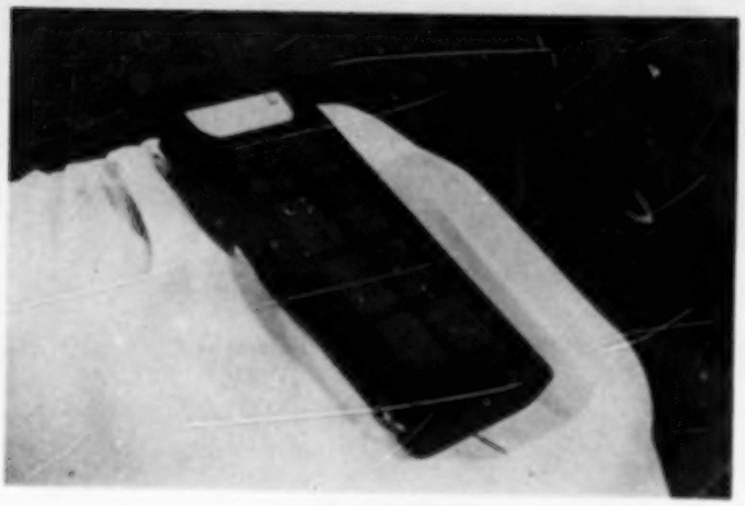
(A pointer light was used with each slide.)

Slide 1.



This is a punchboard. Notice that there are two columns with 20 numbers in each column. For each number there are four holes labeled A, B, C, and D. The first column is numbered from 1-20; the second column is number 21-40. This side, numbered 1-40, will be called side A.

Slide 2.



On side B the columns are numbered 41-60 and 61-80.

Slide 3.

Pull out answer sheets A and B; then turn them over.

Slide 4.

PRINT your first and last name on both answer sheets.

Slide 5.

Now, with side A (numbered 1-40) facing you, slip answer sheet A back into the punchboard from the top.

*Slide 6-IK.

(For immediate knowledge of results groups only.)

Keep answer sheet B in front of you on your desk.

Slide 6-NK.

(For no knowledge of results groups.)

Turn your punchboard over so that side B (numbered 41-80) is facing you, and slip answer sheet B in from the top.

Slide 7.

As you hold the punchboard with your left hand, side A facing you, you will notice in the lower right hand corner, a shiny silver ring. Pull this ring out.

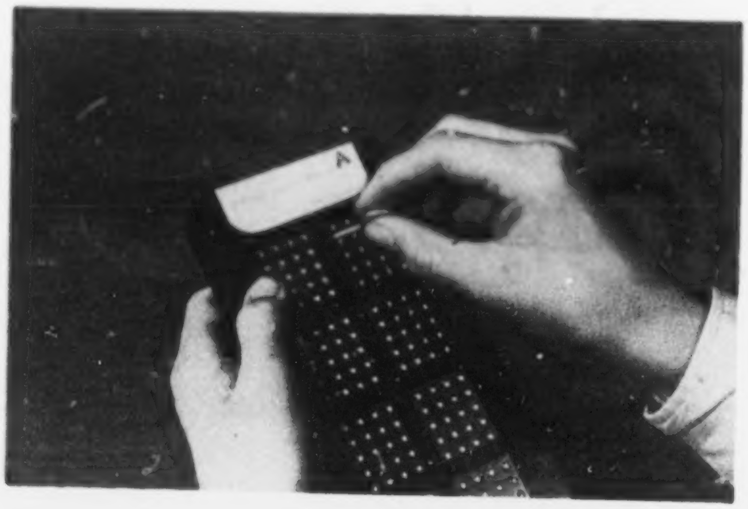
Slide 8.

This is a stylus, which you will use as a punch, to make holes in the answer sheets.

Slide 9.

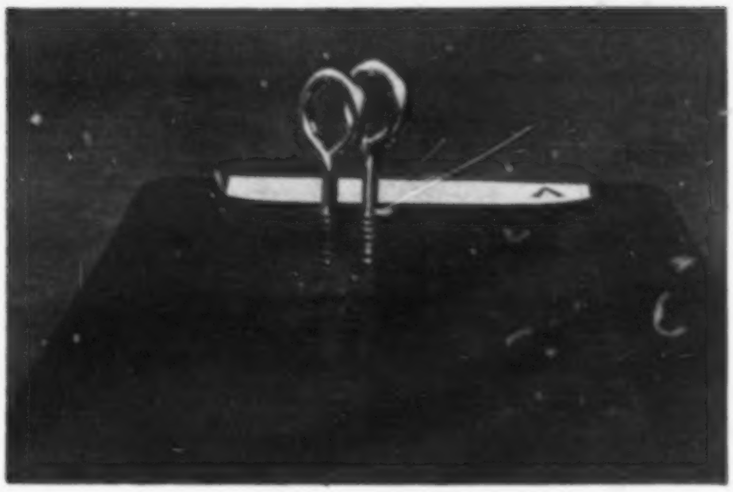
In the first column (numbered 1-20), I want you to use the stylus to punch a hole next to number one under letter A.

Slide 10.



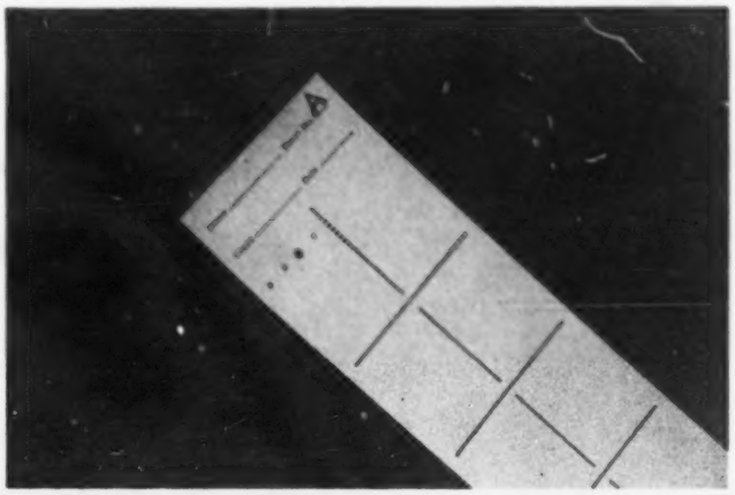
Now, punch holes for letters B, C, and D.

*Slide 11-IK



Notice the hole where the stylus goes in the farthest.

*Slide 12-IK.

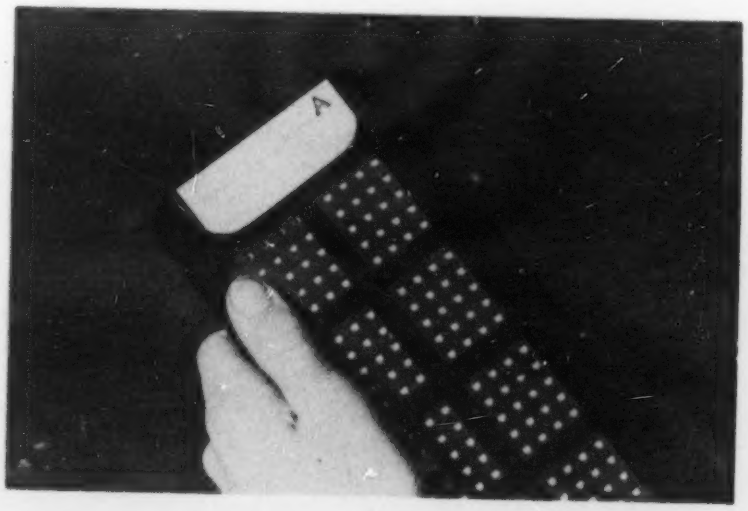


Also, notice that this hole in the answer sheet is larger than the other holes. This is the correct answer. It is letter C. The smaller holes (A, B, and D) indicate wrong answers.

*Slide 13-IK.

Now, write letter C next to number 1 on answer sheet B which is in front of you on your desk. You are to follow this same procedure for the rest of the first column (numbers 2-20). Stop at number 20. Thus, as you discover which answer is right, you are to write its letter on answer sheet B, next to the number which corresponds to the number on the punchboard. Are there any questions? When you finish, slip answer sheet B back in the side numbered 41-80.

Slide 14.



Let me suggest that in using the punchboard you place your thumb under the number on the punchboard which corresponds to the number of the question you are responding to.

* Used with the immediate knowledge of results groups only.

APPENDIX D

Part I - Practice Test

Part II - Science Achievement Test

PART I - PRACTICE TEST

QUESTIONS 21-40

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

INSTRUCTIONS

1. You will use a special device known as a PUNCHBOARD and a STYLUS to record your answers for this test.
2. Be sure your name is printed on the back of the punchboard answer sheets.
3. Follow carefully the directions given you by the test Administrator.
4. Ask any questions you have before the test begins.
5. You are not to mark on this test booklet in any way.

The purpose of this test is to see if you understand how to use the Punchboard. Therefore, you will not find any of the questions in this section difficult.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

21. Who discovered America?

    A. George Washington
    B. Christopher Columbus
    C. Marco Polo
    D. Abraham Lincoln

22. A caterpiller turns into a:

    A. butterfly
    B. small bird
    C. worm
    D. bee

23. This sign (+) means:

    A. divide
    B. multiply
    C. subtract
    D. add

24. How many feet are there in a yard?

    A. 3 feet
    B. 6 feet
    C. 9 feet
    D. 12 feet

25. The Pilgrims came to America on a ship called the:

    A. Mayflower
    B. Sunflower
    C. Orange Blossom
    D. Weed

26. Halloween is in the month of:

    A. April
    B. June
    C. October
    D. December

27. Which of the following animals lives in the water?

    A. bird
    B. whale
    C. dog
    D. elephant

28. What happens when you put a pan of water over a fire?

A. it gets warmer
B. it gets colder
C. it stays the same
D. it freezes

29. Which of the following is a fruit?

A. a potato
B. an apple
C. a bean
D. corn

30. The capital of South Carolina is:

A. Greenville
B. Charleston
C. Spartanburg
D. Columbia

31. Who was the first President of the United States?

A. Christopher Columbus
B. Davey Crockett
C. John Smith
D. George Washington

32. A calf is a baby:

A. horse
B. sheep
C. cow
D. deer

33. How many inches are there in a foot?

A. 6
B. 15
C. 12
D. 8

34. Which of the following animals has four legs?

A. bird
B. horse
C. chicken
D. duck

35. The capital of the United States is:

A. Harrisburg, Pennsylvania
B. Portland, Oregon
C. Houston, Texas
D. Washington, D. C.

36. The Roman numeral IX stands for:

A. 9
B. 7
C. 20
D. 5

37. How many eggs are in a dozen?

A. 6
B. 9
C. 12
D. 18

38. Which letter is nearest the beginning of the alphabet?

A. t
B. e
C. z
D. m

39. How many different states are there in the United States?

A. 30
B. 40
C. 50
D. 60

40. Which of the following places is the greatest distance from the United States?

A. Cuba
B. Mexico
C. Canada
D. Africa

STOP!

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.

PART II - SCIENCE ACHIEVEMENT TEST

QUESTIONS 41-60

Please do your best. Answer every question carefully. You probably will find some of these questions more difficult. You are not expected to answer every question correctly.

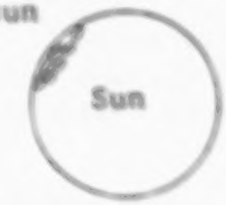
DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

41. Which of the following lines has in it the name of something that is not in our solar system?

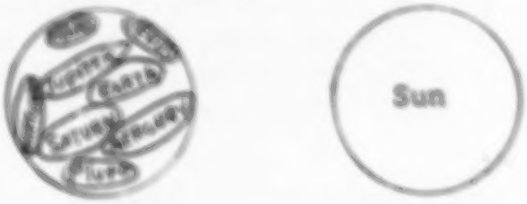
   A. moons, constellations, the sun
   B. the sun, commets, meteors
   C. planets, moons, asteroids
   D. asteroids, planets, meteors

42. In comparing the sun to the planets in our solar system in size, which of the following is correct?

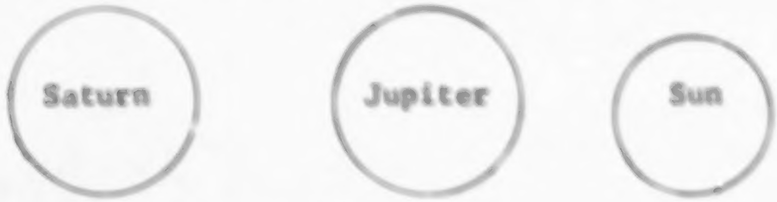
   A. All the planets would fit in a small corner of the sun



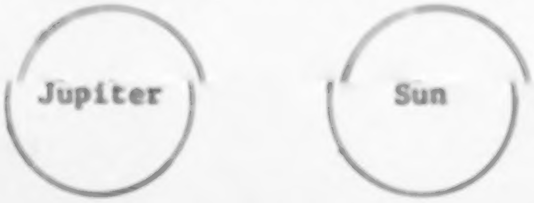
   B All the planets together are as large as the sun


Jupiter
Earth
Saturn
Mercury
Pluto
Sun

   C. Some planets are larger than the sun

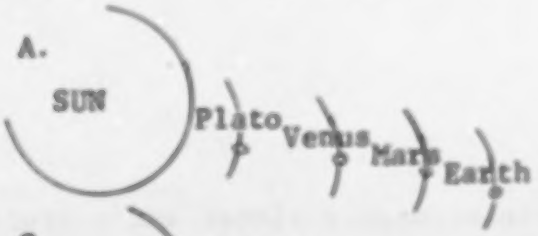

Saturn
Jupiter
Sun

   D. Jupiter, by itself, is as large as the sun

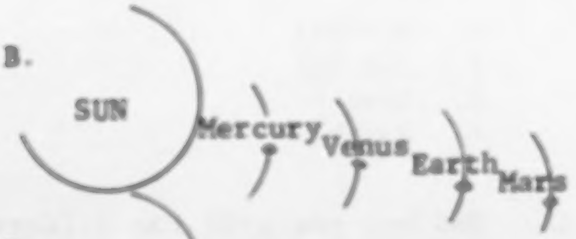

Jupiter
Sun

43. The four planets nearest the sun are called the inner planets. We call these planets:

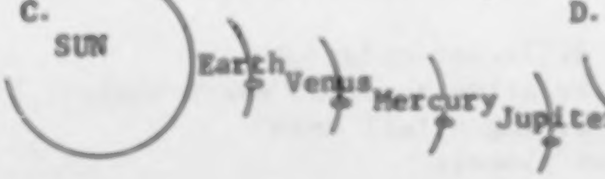
A.


SUN
Plato
Venus
Mars
Earth

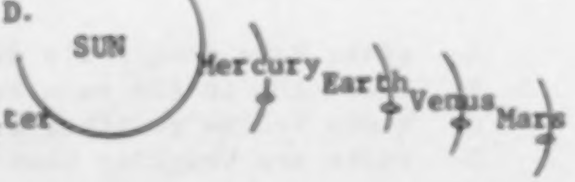
B.


SUN
Mercury
Venus
Earth
Mars

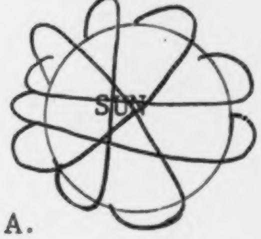
C.


SUN
Earth
Venus
Mercury
Jupiter

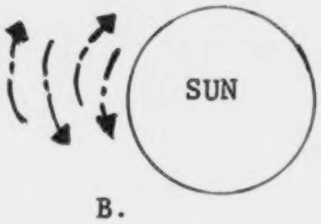
D.


SUN
Mercury
Earth
Venus
Mars

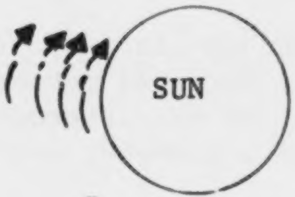
44. Which diagram shows the correct movement of planets around the sun?



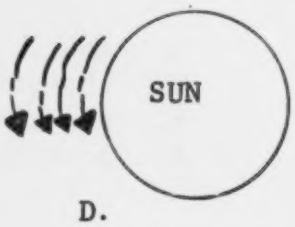
A.



B.



C.



D.

45. What is a year in terms of each planet in the solar system?

A. the speed of rotation
B. the time it takes to turn on its axis
C. the time it takes to go around the sun
D. the time it takes to make four revolutions

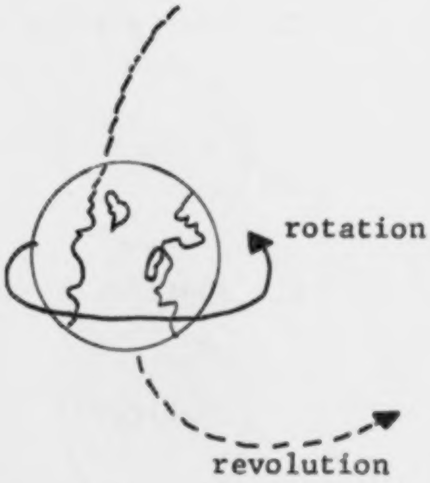
46. Refer to the diagram at the right. Which statement below is correct?

A. the side nearest the word rotation is in daylight

B. The side opposite the word rotation is in daylight

C. The words revolution and rotation should be interchanged

D. The arrow along side of revolution should point the other way



47. Which planet has the shortest rotation period?

A. Mercury
B. Jupiter
C. Uranus
D. Earth

48. How can you tell the difference between a planet and a star?

A. stars have a slightly different color
B. stars are in the same relative position every night
C. stars become brighter during a full moon
D. stars are brighter than planets

49. Mercury and Venus are seen only near the sun either at dawn or at sunset because:

    A. they are too dim
    B. at that time they are not hidden by clouds
    C. they are moving too fast
    D. they are between the sun and earth

50. As they appear to cross the earth's sky:

    A. some planets follow one path and some follow another
    B. all planets follow the same path, but a different one from that followed by the sun and moon
    C. all planets follow somewhat different paths
    D. all planets follow the same path as the moon and sun

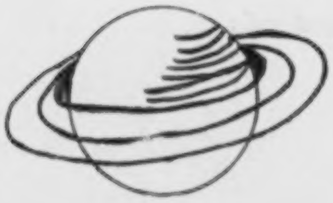
51. Which of the following planets can be seen without the aid of a telescope?

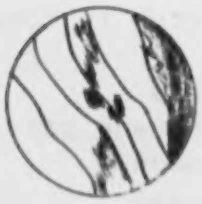
    A. Uranus
    B. Mercury
    C. Neptune
    D. Pluto

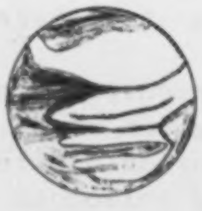
52. To study the planets a telescope may be used:

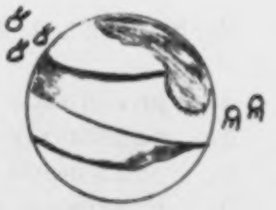
    A. to filter out haze and dust that dims planet images
    B. only to brighten the planet images
    C. only to magnify the planet images
    D. to brighten and magnify planet images

53. Select from the four drawings below the picture that most closely resembles the picture of Saturn:


A.


B.

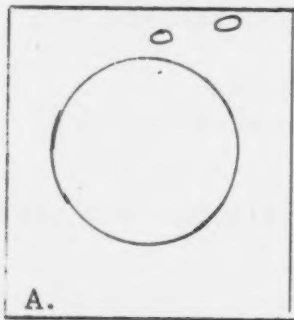

C.

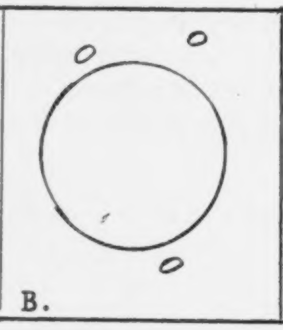

D.

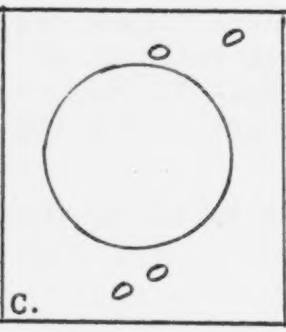
54. Neptune was found:

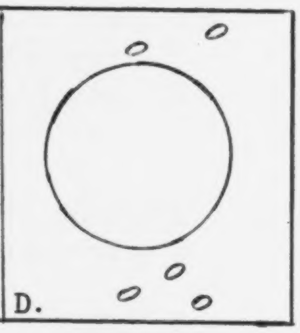
A. when its shadow hid Pluto from our microscopes
B. when it was discovered something was disturbing the orbit of Uranus
C. by telescope after its location was mathematically predicted
D. when it passed to the right of the sun 113 years ago

55. In the four pictures of Uranus below, choose the one with the correct number of moons:


A.


B.


C.


D.

56. Venus is completely covered by clouds, and so very little is known about it. We do know that it:

A. is the brightest of the planets
B. is larger than our earth
C. is the fastest moving planet of the inner planets
D. has snow-covered mountains

57. We know that Mars is:

A. always colder than the earth
B. colder than the earth in winter but warmer in summer
C. warmer than the earth at the equator but colder at the poles
D. colder than earth at night but warmer during the day

58. We know that the atmosphere on Jupiter is composed of:

A. poisonous ammonia and methane gas
B. poisonous carbon monoxide and ethane gas
C. poisonous carbon dioxide and ammonia
D. hydrogen and poisonous methane gas

59. How many moons does Jupiter have?

    A. two moons
    B. four moons
    C. nine moons
    D. twelve moons

60. It is easy to remember the number of moons circling Saturn because it is the same number as:

    A. the moons of Mars
    B. the moons of Jupiter
    C. the moons of Mercury
    D. the planets in our solar system

STOP!

APPENDIX E

Directions for Filmstrip Presentation and Testing Sessions

DIRECTIONS FOR THE TREATMENT SESSION

Today I am going to show you a filmstrip entitled Earth's Satellite: The Moon. I am going to present this filmstrip

*(1) a frame at a time
(2) a sequence at a time, i.e., two or more related frames
(3) in its entirety.

*(1) Each frame
(2) Each sequence
(3) The entire filmstrip

will be followed by one or more test questions. The test questions will cover the material contained in the captions of the filmstrip as well as the pictorial elements. Therefore, I urge you to read each caption silently along with me and to study the visual elements carefully.

In recording your answers, you will use the punchboard device which you were introduced to the other day. At this time, I am going to pass out the punchboards to you. When you receive yours, pull out answer sheets A and B and print your first and last name on the back of each. When you have done this, put answer sheet A back in the side of the punchboard numbered 1-40, and answer sheet B back in the side numbered 41-80.

The questions over

*(1) each frame
(2) each sequence
(3) the entire filmstrip

will appear on the screen. As they do, you are to read each question silently but carefully and decide which response you think is correct

(A, B, C, or D). You are then to record your answer by punching a hole for the letter of this response.

> If the hole is small and if the stylus doesn't go in all the way, you will know your answer is wrong. In this case, you are to select another answer and record it by punching another hole. You will continue to do this until you have found the right answer, i.e., the hole in which the stylus has gone in the farthest, thus making the larger hole in the answer sheet.**

When you have

*(1) answered the question
(2) found the right answer

leave your stylus in that hole and take your hands completely off of it. After everyone has recorded his answer (correctly)**, we will go on to the next question

*(1) or to the next frame
(2) or to the next sequence.

Before we do, however, I will say the word "next." If you haven't

*(1) answered the question
(2) found the right answer

raise your hand. We will wait for you briefly to record your answer. We must insist that you follow these directions.

Are there any questions as to how we will proceed?

---

* One of these statements was read depending on the method of filmstrip presentation and on whether the group received immediate knowledge of results or no knowledge of results.

** This statement was given only in those groups receiving immediate knowledge of results.

DIRECTIONS FOR THE DELAYED KNOWLEDGE OF RESULTS TESTING SESSION

Today we are going to take the same test over the filmstrip, Earth's Satellite: The Moon, which you took yesterday.

At this time, I am going to pass out the punchboards to you. Pull out answer sheets A and B and print your first and last name on the back of each. When you have done this, put answer sheet A back in the side of the punchboard numbered 1-40, and answer sheet B back in the side numbered 41-80.

Today as you read each question and decide which response you think is correct (A, B, C or D), you are to record your answer by punching a hole for this response only. Leave the stylus in this hole, take your hands completely off of it, and wait for the next question to appear. I will say the word "next." If you haven't answered the question, please raise your hand. After everyone has answered the question, I will announce and point to the correct letter on the screen and with my pointer light I will underscore this response while you read it silently. We will then go on to the next question. After you have decided on your answer to that question, you may move your stylus. We must insist that you follow these directions.

Are there any questions?

DIRECTIONS FOR THE RETENTION TESTING SESSION

Today we are going to take the same test over the filmstrip, Earth's Satellite: The Moon, which you took approximately three weeks ago.

I realize you may have forgotten the answers to some of the questions, but you should try to do your best and guess if necessary.

At this time, I am going to pass out the punchboards to you. Pull out answer sheets A and B and print your first and last name on the back of each. When you have done this, put answer sheet A back in the side of the punchboard numbered 1-40, and answer sheet B back in the side numbered 41-80.

As the questions appear on the screen, you are to read each question and decide which response you think is correct, (A, B, C, or D). Record your answer by punching a hole for the letter of that response on your punchboard. Leave the stylus in this hole and take your hands completely off of it, and wait for the next question. You will not be told the correct answer today. You are to punch only once for each question. I will say the word "next." If you haven't answered the question, please raise your hand. We will wait for you briefly to record your answer. When the next question appears on the screen, you are to read it and after you have decided on your answer you may move your stylus. We must insist that you follow these directions.

Are there any questions?

APPENDIX F

Prospectus Submitted to County School Office and to Participating Principals

Greenville County Schools, Greenville, South Carolina

TITLE VII PROJECT DATA SHEET

March 1962

Project Title: Knowledge of Results and Continuity of Various Techniques in Presenting a Filmstrip as Factors in Immediate Learning and Retention.

Project Description: See Attached Sheets*

Advantages to be Gained from Participation:

A. For the School System

1. By making a professional contribution by participation in a government sponsored research program that will be reported on a national basis.
2. By helping by contribution to our knowledge of programmed presentations and the effects of immediate knowledge of results on learning and retention.
3. By adding support to other studies now being conducted along similar lines.

B. For the Pupil

1. Learning content material from a filmstrip on the Moon.
2. Learning about the latest trends in instruction which they in the future will encounter in industry and college and using one of the latest techniques -- the Punchboard which is by definition a Teaching Machine.

Filmstrip Title: Earth's Satellite: The Moon (SVE)

Methods of Presentation:

1. Frame by Frame
2. By Sequence
3. Whole Method

Techniques of Evaluation: Use of objective test and Punchboard Device with and without immediate knowledge of results.

*Philip D. Smith, Application to the Commissioner of Education, Bob Jones University, January, 1961.

Control Variables:

1. Intelligence
2. Pre-test of Achievement on Solar System
3. Socio-Economic Background

Number of Students and Grade Levels Needed:

Elementary - Grades 5 and 6	- Total 360
School - 1 - Method - 1	120 Pupils
School - 2 - Method - 2	120 Pupils
School - 3 - Method - 3	120 Pupils
Junior High - Grade 8	- Total 360
Method - 1	120 Pupils
Method - 2	120 Pupils
Method - 3	120 Pupils
High School - Grade 11	- Total 360
Method - 1	120 Pupils
Method - 2	120 Pupils
Method - 3	120 Pupils

Control and Experimental Groups:

For each method involving 120 pupils, 60 of them randomly assigned will comprise the control group and the other 60 will comprise the experimental group. This means that the following schedule will need to be duplicated each day. One group will receive immediate knowledge of results; the other group will be given only delayed knowledge of results.

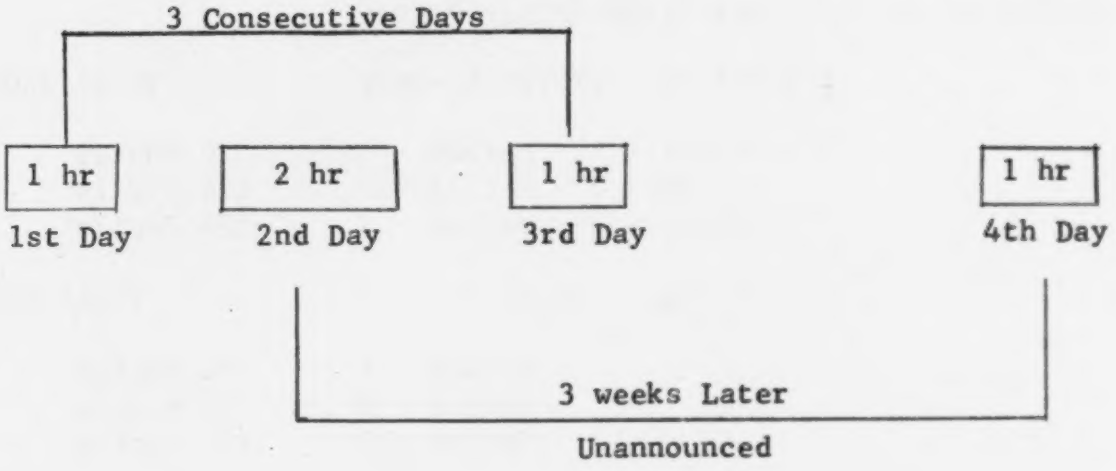
Schedule to be Followed:

First Day - Acquaintance with Punchboard
Pre-test: Solar System

Second Day - Filmstrip presentation by Method 1, 2 or 3

Third Day - Delayed knowledge of results

Fourth Day - Measure of retention


3 Consecutive Days
1 hr
1st Day
2 hr
2nd Day
1 hr
3rd Day
1 hr
4th Day
3 weeks Later
Unannounced

APPENDIX G

Tables 58 to 64

TABLE 58

A DESCRIPTION OF THE ACTIVE SAMPLE FOR METHODS VARIABLES

Methods	Number			IQ			Sci. Achiev. Test		
	Boys	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
1. Frame	143	125	268	78-150	110.78	14.10	2-17	8.77	2.55
2. Sequence	125	124	249	75-145	109.92	12.92	2-17	8.91	3.13
3. Whole	132	96	228	77-141	106.42	11.46	1-16	8.85	2.65
Total	400	345	745	75-150	109.16	13.07	1-17	8.84	2.78

Methods	Session 2#			Session 3#			Session 4#		
	Range	$\overline{X}$*	SD	Range	$\overline{X}$*	SD	Range	$\overline{X}$*	SD
1. Frame	22-79	62.17	10.41	24-80	61.07	11.54	16-77	52.60	11.86
2. Sequence	23-78	57.24	12.61	15-79	62.23	12.28	20-80	53.78	13.10
3. Whole	18-76	52.16	12.92	28-80	59.32	11.92	22-79	51.58	12.37
Total	18-79	57.46	12.64	15-80	60.92	11.96	16-80	52.68	12.47

2. Treatment Session, 3. Delayed Knowledge of Results Testing Session, 4. Retention Testing Session.

* Unadjusted means.

TABLE 59

A DESCRIPTION OF THE ACTIVE SAMPLE FOR KNOWLEDGE OF RESULTS VARIABLES

Results	Number			IQ			Sci. Achiev. Test		
	Boys	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
1. I Know+	192	163	355	77-147	110.07	12.52	2-17	9.12	2.76
2. No Know++	208	182	390	75-150	108.33	13.49	1-17	8.59	2.78
Total	400	345	745	75-150	109.16	13.07	1-17	8.84	2.78

+ IK means Immediate knowledge of results (Experimental group).
++ NK means No knowledge of results (Control group).

Results	Session 2#			Session 3#			Session 4#		
	Range	$\overline{X}$*	SD	Range	$\overline{X}$*	SD	Range	$\overline{X}$*	SD
1. I Know+	18-79	57.95	12.77	15-80	62.77	11.25	16-79	53.69	11.83
2. No Know++	22-78	57.01	12.51	23-80	59.24	12.34	20-80	51.77	12.96
Total	18-79	57.46	12.64	15-80	60.92	11.96	16-80	52.68	12.47

# 2. Treatment Session, 3. Delayed Knowledge of Results Testing Session, 4. Retention Testing Session.
* Unadjusted Means.
+ IK means Immediate knowledge of results (Experimental group).
++ NK means No knowledge of results (Control group).

TABLE 60

A DESCRIPTION OF THE ACTIVE SAMPLE FOR GRADE LEVEL VARIABLES

Grades	Number			IQ			Sci. Achiev. Test		
	Boys	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
1. 5-6	152	123	275	75-150	110.43	14.29	2-17	8.23	2.46
2. 7-8	135	113	248	81-145	109.58	13.47	1-17	8.73	2.94
3. 11	113	109	222	78-138	107.11	10.54	3-17	9.72	2.77
Total	400	345	745	75-150	109.16	13.07	1-17	8.84	2.78

Grades	Session 2$^{\#}$			Session 3$^{\#}$			Session 4$^{\#}$		
	Range	$\overline{X}$*	SD	Range	$\overline{X}$*	SD	Range	$\overline{X}$*	SD
1. 5-6	18-79	52.16	12.66	23.80	56.26	12.41	16-73	48.07	11.67
2. 7-8	22-78	56.21	12.22	15-80	60.33	11.69	21-77	51.40	11.60
3. 11	37-78	65.41	8.45	39-80	67.36	8.26	26-80	59.83	11.13
Total	18-79	57.46	12.64	15-80	60.92	11.96	16-80	52.68	12.47

2. Treatment Session, 3. Delayed Knowledge of Results Testing Session, 4. Retention Testing Session.

* Unadjusted Means.

TABLE 61

A DESCRIPTION OF THE ACTIVE SAMPLE FOR METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES

Methods x Results	Number			IQ			Sci. Achiev. Test		
	Boys	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
1. Frame IK^{+}	73	62	135	85-147	112.05	12.90	2-17	9.19	2.64
2. Sequence IK	58	57	115	81-145	111.56	12.43	3-17	9.31	3.02
3. Whole IK	61	44	105	77-140	105.89	11.03	3-16	8.82	2.58
4. Frame NK^{++}	70	63	133	78-150	109.48	15.12	3-15	8.35	2.39
5. Sequence NK	67	67	134	75-142	108.51	13.12	2-17	8.56	3.17
6. Whole NK	71	52	123	81-141	106.88	11.79	1-15	8.88	2.70
Total	400	345	745	78-150	109.16	13.07	1-17	8.84	2.78

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 61 (continued)

Methods x Results	Session 2$^{\#}$			Session 3$^{\#}$			Session 4$^{\#}$		
	Range	$\bar{X}$*	SD	Range	$\bar{X}$*	SD	Range	$\bar{X}$*	SD
1. Frame IK^{+}	22-79	62.37	11.33	25-80	63.08	10.78	16-77	54.03	12.26
2. Sequence IK	31-78	58.54	11.57	15-79	65.16	10.62	24-77	55.33	11.75
3. Whole IK	18-76	51.63	13.19	32-80	59.76	11.81	22-79	51.46	10.99
4. Frame NK^{++}	36-77	61.96	9.37	24-78	59.02	11.92	22-75	51.15	11.26
5. Sequence NK	23-78	56.13	13.35	23-79	59.72	13.02	20-80	52.46	14.02
6. Whole NK	22-76	52.61	12.67	28-80	58.95	12.01	24-77	51.69	13.44
Total	18-79	57.46	12.64	15-80	60.92	11.96	16-80	52.68	12.47

# 2. Treatment Session, 3. Delayed Knowledge of Results Testing Session, 4. Retention Testing Session.
* Unadjusted Means.
+ IK means Immediate knowledge of results (Experimental group).
++ NK means No knowledge of results (Control group).

TABLE 61

A DESCRIPTION OF THE ACTIVE SAMPLE FOR METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES

Methods x Results	Number			IQ			Sci. Achiev. Test		
	Boys	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
1. Frame IK^{+}	73	62	135	85-147	112.05	12.90	2-17	9.19	2.64
2. Sequence IK	58	57	115	81-145	111.56	12.43	3-17	9.31	3.02
3. Whole IK	61	44	105	77-140	105.89	11.03	3-16	8.82	2.58
4. Frame NK^{++}	70	63	133	78-150	109.48	15.12	3-15	8.35	2.39
5. Sequence NK	67	67	134	75-142	108.51	13.12	2-17	8.56	3.17
6. Whole NK	71	52	123	81-141	106.88	11.79	1-15	8.88	2.70
Total	400	345	745	78-150	109.16	13.07	1-17	8.84	2.78

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 62

A DESCRIPTION OF THE ACTIVE SAMPLE FOR GRADE LEVEL VARIABLES X KNOWLEDGE OF RESULTS VARIABLES

Grades x Results	Number			IQ			Sci. Achiev. Test		
	Boys	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
1. 5-6 IK^{+}	72	55	127	77-147	111.13	13.37	2-17	8.39	2.54
2. 7-8 IK	68	52	120	85-145	110.79	13.42	3-17	9.48	2.97
3. 11 IK	52	56	108	81-138	108.02	9.94	3-15	9.58	2.59
4. 5-6 NK^{++}	80	68	148	75-150	109.83	15.00	3-15	8.10	2.38
5. 7-8 NK	67	61	128	81-141	108.44	13.41	1-15	8.02	2.72
6. 11 NK	61	53	114	78-132	106.25	11.01	4-17	9.85	2.92
Total	400	345	745	75-150	109.16	13.07	1-17	8.84	2.78

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 62 (continued)

Grades x Results	Session 2[#]			Session 3[#]			Session 4[#]		
	Range	$\bar{X}$*	SD	Range	$\bar{X}$*	SD	Range	$\bar{X}$*	SD
1. 5-6 IK[+]	18-79	51.46	13.89	25-79	57.91	12.44	16-73	49.17	11.87
2. 7-8 IK	22-78	59.10	11.19	15-80	63.35	10.45	29-77	54.00	10.55
3. 11 IK	37-77	64.31	8.87	47-80	67.85	7.66	26-79	58.67	11.05
4. 5-6 NK[++]	23-77	52.76	11.47	23-80	54.85	12.22	20-73	47.14	11.41
5. 7-8 NK	22-77	53.51	12.51	24-79	57.50	12.07	21-74	48.97	12.02
6. 11 NK	41-78	66.46	7.89	39-79	66.89	8.76	36-80	60.93	11.09
Total	18-79	57.46	12.64	15-80	60.92	11.96	16-80	52.68	12.47

[#] 2. Treatment Session, 3. Delayed Knowledge of Results Testing Session, 4. Retention Testing Session.
[*] Unadjusted Means.
[+] IK means Immediate knowledge of results (Experimental group).
[++] NK means No knowledge of results (Control group).

TABLE 63

A DESCRIPTION OF THE ACTIVE SAMPLE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES

Grades x Method	Number			IQ			Sci. Achiev. Test		
	Boys	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
1. 5-6 Frame	63	48	111	78-150	115.50	14.80	2-17	8.55	2.52
2. 5-6 Sequence	42	39	81	75-142	106.80	12.93	4-14	7.56	2.39
3. 5-6 Whole	47	36	83	77-140	107.18	12.75	5-16	8.47	2.31
4. 7-8 Frame	42	45	87	84-140	109.72	13.37	3-16	8.72	2.47
5. 7-8 Sequence	49	45	93	81-145	112.85	13.25	2-17	8.95	3.29
6. 7-8 Whole	44	24	68	81-141	104.91	12.49	1-15	8.44	2.94
7. 11 Frame	38	32	70	78-125	104.59	10.81	4-15	9.19	2.66
8. 11 Sequence	34	41	75	81-138	109.64	11.51	3-17	10.32	2.98
9. 11 Whole	41	36	77	87-124	106.94	8.55	3-15	9.62	2.53
Total	400	345	745	75-150	109.16	13.07	1-17	8.84	2.78

TABLE 63 (continued)

Grades x Method	Session 2#			Session 3#			Session 4#		
	Range	$\bar{X}$*	SD	Range	$\bar{X}$*	SD	Range	$\bar{X}$*	SD
1. 5-6 Frame	22-79	59.31	11.40	25-79	59.04	12.21	16-73	50.94	12.28
2. 5-6 Sequence	23-72	49.84	11.25	23-77	56.30	12.78	20-73	47.06	11.68
3. 5-6 Whole	18-65	44.88	10.36	28-80	52.51	11.28	22-70	45.23	9.80
4. 7-8 Frame	32-78	61.61	9.86	24-80	59.76	11.65	29-77	52.13	12.25
5. 7-8 Sequence	25-78	56.32	11.96	15-79	62.17	11.93	21-75	52.17	10.93
6. 7-8 Whole	22-72	49.16	11.71	32-79	58.54	11.03	24-74	49.43	11.42
7. 11 Frame	51-77	67.40	6.88	39-78	65.90	8.54	26-75	55.83	9.88
8. 11 Sequence	43-78	66.39	8.37	41-79	68.71	8.21	36-80	63.04	11.68
9. 11 Whole	37-76	62.65	9.08	47-80	67.36	7.81	36-79	60.34	10.50
Total	18-79	57.46	12.64	15-80	60.92	11.96	16-80	52.68	12.47

2. Treatment Session, 3. Delayed Knowledge of Results Testing Session, 4. Retention Testing Session.

* Unadjusted Means.

TABLE 64

A DESCRIPTION OF THE ACTIVE SAMPLE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES

Grade 5-6		Number			IQ		
		Boys	Girls	Total	Range	$\overline{X}$	SD
1. Frame	IK$^+$	30	25	55	85-147	115.58	12.48
2.	NK^{++}	33	23	56	78-150	115.43	16.77
3. Sequence	IK	22	14	36	84-136	109.75	11.80
4.	NK	20	25	45	75-142	104.44	13.30
5. Whole	IK	20	16	36	77-140	105.69	13.86
6.	NK	27	20	47	87-134	108.32	11.70
Grade 7-8							
7. Frame	IK	24	20	44	85-140	111.16	14.18
8.	NK	18	25	43	84-138	108.26	12.31
9. Sequence	IK	24	21	45	92-145	114.49	12.51
10.	NK	25	23	48	81-140	111.31	13.74
11. Whole	IK	20	11	31	88-134	104.90	11.39
12.	NK	24	13	37	81-141	104.92	13.35
Grade 11							
13. Frame	IK	19	17	36	88-125	107.75	10.09
14.	NK	19	15	34	78-125	101.24	10.53
15. Sequence	IK	12	22	34	81-138	109.59	12.23
16.	NK	22	19	41	90-132	109.68	10.88
17. Whole	IK	21	17	38	92-124	106.87	6.85
18.	NK	20	19	39	87-124	107.00	9.93
Total		400	345	745	75-150	109.16	13.07

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 64

A DESCRIPTION OF THE ACTIVE SAMPLE FOR GRADE LEVEL VARIABLES X METHODS VARIABLES X KNOWLEDGE OF RESULTS VARIABLES

Number			IQ			Sci. Achiev. Test		
s	Girls	Total	Range	$\overline{X}$	SD	Range	$\overline{X}$	SD
	25	55	85-147	115.58	12.48	2-17	8.95	2.62
	23	56	78-150	115.43	16.77	3-15	8.16	2.35
	14	36	84-136	109.75	11.80	4-14	7.56	2.25
	25	45	75-142	104.44	13.30	4-13	7.56	2.49
	16	36	77-140	105.69	13.86	5-16	8.36	2.44
	20	47	87-134	108.32	11.70	5-13	8.55	2.20
	20	44	85-140	111.16	14.18	3-16	9.30	2.64
	25	43	84-138	108.26	12.31	4-13	8.14	2.13
	21	45	92-145	114.49	12.51	5-17	10.24	3.19
	23	48	81-140	111.31	13.74	2-14	7.73	2.89
	11	31	88-134	104.90	11.39	4-15	8.65	2.79
	13	37	81-141	104.92	13.35	1-15	8.27	3.06
	17	36	88-125	107.75	10.09	4-15	9.44	2.64
	15	34	78-125	101.24	10.53	4-14	8.91	2.65
	22	34	81-138	109.59	12.23	3-15	9.94	2.69
	19	41	90-132	109.68	10.88	5-17	10.63	3.16
	17	38	92-124	106.87	6.85	3-14	9.39	2.41
	19	39	87-124	107.00	9.93	5-15	9.85	2.63
	345	745	75-150	109.16	13.07	1-17	8.84	2.78

owledge of results (Experimental group).

of results (Control group).

TABLE 64 (continued)

Grade 5-6		Session 2#			Session 3#		
		Range	$\bar{X}$*	SD	Range	$\bar{X}$*	SD
1. Frame	IK+	22-79	58.58	13.09	25-79	60.07	12.9
2.	NK++	36-77	60.02	9.39	36-77	58.04	11.3
3. Sequence	IK	31-67	51.17	10.87	30-77	60.64	11.0
4.	NK	23-72	48.48	11.43	23-74	52.82	13.0
5. Whole	IK	18-65	40.89	10.53	33-75	51.86	10.8
6.	NK	28-63	47.94	9.12	28-80	53.00	11.5
Grade 7-8							
7. Frame	IK	32-78	62.86	10.13	48-80	64.05	8.6
8.	NK	36-77	60.33	9.40	24-77	55.37	12.6
9. Sequence	IK	37-78	59.51	10.62	15-79	64.93	11.5
10.	NK	25-75	53.33	12.38	30-79	59.58	11.6
11. Whole	IK	22-71	53.16	10.95	32-79	60.06	10.3
12.	NK	22-72	45.81	11.27	36-79	57.27	11.4
Grade 11							
13. Frame	IK	54-77	67.56	6.74	48-78	66.50	7.9
14.	NK	51-77	67.24	7.02	39-78	65.26	9.1
15. Sequence	IK	43-77	65.06	8.76	59-79	70.24	5.38
16.	NK	49-78	67.49	7.87	41-79	67.44	9.78
17. Whole	IK	37-76	60.55	9.34	47-80	67.00	8.63
18.	NK	41-76	64.69	8.32	48-79	67.72	6.90
Total		18-79	57.46	12.64	15-80	60.92	11.96

# 2. Treatment Session, 3. Delayed Knowledge of Results Testing Session, 4. Retention

* Unadjusted Means.

+ IK means Immediate knowledge of results (Experimental group).

++ NK means No knowledge of results (Control group).

TABLE 64 (continued)

Session 2[#]		Session 3[#]			Session 4[#]		
X̄*	SD	Range	X̄*	SD	Range	X̄*	SD
58.58	13.09	25-79	60.07	12.93	16-73	52.07	13.28
60.02	9.39	36-77	58.04	11.38	22-73	49.82	11.11
51.17	10.87	30-77	60.64	11.02	24-73	49.61	10.65
48.48	11.43	23-74	52.82	13.03	20-73	45.02	12.07
40.89	10.53	33-75	51.86	10.85	22-67	44.28	8.78
47.94	9.12	28-80	53.00	11.57	25-70	45.96	10.46
62.86	10.13	48-80	64.05	8.66	30-77	54.95	11.40
60.33	9.40	24-77	55.37	12.64	29-74	49.23	12.42
59.51	10.62	15-79	64.93	11.56	34-75	54.53	10.17
53.33	12.38	30-79	59.58	11.69	21-72	49.96	11.15
53.16	10.95	32-79	60.06	10.37	29-74	51.87	9.47
45.81	11.27	36-79	57.27	11.40	24-71	47.38	12.46
67.56	6.74	48-78	66.50	7.90	26-75	55.89	11.16
67.24	7.02	39-78	65.26	9.13	40-75	55.76	8.32
65.06	8.76	59-79	70.24	5.38	40-77	62.44	11.14
67.49	7.87	41-79	67.44	9.78	36-80	63.54	12.09
60.55	9.34	47-80	67.00	8.63	43-79	57.92	9.86
64.69	8.32	48-79	67.72	6.90	36-77	62.69	10.58
57.46	12.64	15-80	60.92	11.96	16-80	52.68	12.47

layed Knowledge of Results Testing Session, 4. Retention Testing Session.

e of results (Experimental group).

sults (Control group).